European Operating Room Nurses Association

EORNA Best Practice for perioperative care

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EORNA best practice for Perioperative care

The recommended practices are developed with the purpose to provide guidelines for perioperative nurses in their nursing care in relation to surgery to achieve patient safety. The recommended practice is aimed for perioperative nurses in countries in Europe, and internationally. Nurses' code of ethics (ICN, 2012), nurses' specialist framework (ESNO, 2015), nurses' core competences (QSEN, 2003; Cronenwett et al., 2007; Cronenwett, 2009) and description of competence (EORNA, 2019) are important fundamental documents according to the recommendations.
Intentions with the recommendations are that every unique patient should be offered safe perioperative nursing care from the perspective of evidence-based nursing by all co-workers and members in the surgical team.
These recommendations may be of advantage for practice in healthcare and especially in the operating rooms.
EORNA recognizes the various settings in which surgical procedures are performed and where perioperative nurses' practices.
The recommendation was developed by the EORNA Perioperative Nursing Care Committee.

European Operating Room Nurses Association

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Part 1

Perioperative care practices

1.1. Theory of Anticipatory Vigilance – A Theory for Perioperative Nurses

Perioperative nursing as a profession is central to effective health service delivery for the surgical patient (Rothrock, 2011). The perioperative environment is in a constant state of change in a climate of safety, risk management, professionalism, accountability, and consumerism, which influence nurses working in the perioperative setting. An ability to work within an increasing range of technology while providing and overseeing the provision of patient care to the surgical patient is essential in reducing risk and promoting patient safety. Maintaining a safe environment is dependent on the perioperative nurse maintaining an optimal level of practice, encompassing moral, legal standards, education, autonomy, accountability, decision making, ethical standards, management, and leadership (AORN 2012).
Patient safety and risk management is now both an international and global priority (Battles & Lilford 2003) where the goal is to lessen the possibility of injury or risk to patients within the structure and processes of care given. Safety is a complex multifaceted phenomenon, yet it is essential that all perioperative nurses must understand and possess the skills to ensure that patients are not exposed to error. Providing safe care is a primary role of the perioperative nurse (O' Brien 2012, AORN 2014). A rich source of information regarding safety within the perioperative setting can be obtained from the nurses who work there daily. They need to be more aware of their role in minimizing risk in the perioperative setting.
The doctoral study on: 'Anticipatory Vigilance: A classic grounded theory of risk reduction and management in the perioperative setting' aimed to achieve this. This perioperative nursing theory explains the main behaviors and attitudes of nurses working in the perioperative setting when minimizing risk.

The Theory of Anticipatory Vigilance
The nurses' main concern of minimizing risk in this high risk, highly structured setting, ensuring safety is related to achieving a positive and successful experience for all patients in their care before, during and after surgery. Anticipatory vigilance is how perioperative nurses minimize risk in this setting. Anticipatory vigilance refers to the strategies that perioperative nurses use to resolve their main concern of minimizing risk in the perioperative setting. Nurses engage in and practice anticipatory vigilance in three ways, through orchestrating, routinizing and momentary adapting. These are intrinsically linked through trusting relations. Each category has a related dependency on one another in assisting and shaping the theory of anticipatory vigilance.

Trusting relations is a necessary precondition for minimizing risk through anticipatory vigilance. It underpins the process of orchestrating, routinizing and momentary adapting.
Orchestrating consists of macro orchestrating, locational orchestrating, situational orchestrating and being in the know. It is the strategy used by nurses in managing people & workloads in an informed way.
Routinizing consists of habitual checking, rule following, mutual watching and mutual dependency. It is the strategy used by nurses in how work, tasks or activities are carried out.
Momentary adapting consists of rapid responsible responding, temporary structuring, heightened awareness and advanced knowing. It is the strategy used by nurses in responding to unscheduled or unexpected events which is part of daily work.
The ability of nurses to engage in anticipatory vigilance is dependent on the level of competency of the nurse when engaging in orchestrating, routinising and momentary adapting.
Implications of the practice

This *Grounded Theory* study offers an explanation as to how perioperative nurses are constantly in a state of 'anticipatory vigilance' throughout their working day to minimize risk in the perioperative setting. Identifying this theory endeavors to promote quality care in the perioperative setting, which has the potential to lead to positive patient outcomes. It provides insight, understanding and awareness of the work nurses in the perioperative setting do.

- The terms of attention, alertness, anticipating, being present in the moment and watchfulness emerged as properties within the theory of anticipatory vigilance which may help both the novice and experience perioperative nurses to be aware, understand and guide their practice safely.
- Has the potential to inform and impact on the use of current policies, rules, and regulations through justifying the need for recommended practices and adhering to guidelines and policies.
- Identifies the necessity for advanced knowledge, competence, and training to understand the need for "Anticipatory Vigilance" to minimize risk thus influences positive patient outcomes.
- Offers awareness of the work perioperative nurses undertake enabling understanding of the complexities of their role and the structures within the setting.
- Has the potential to inform the national debate on teaching and training.
- Adds to the already available body of knowledge on risk and safety by linking vigilance, risk and nursing, leading to greater awareness of the reality and the consequences of minimizing and safety in the workplace.

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1.2. EORNA best practice for evidence-based practice

Statement
EORNA is dedicated to the promotion of safe outcomes for patients in the operating room.
EORNA recognizes the need for the implementation of standard processes developed by national and international, safety or regulatory agencies in Europe.
Multidisciplinary teams that include perioperative nurses, surgeons, anesthesia providers and risk managers, should collaboratively develop evidence-based policies.

Key words
Database, evidence base , practical decision, guidelines

Purpose/objective
Evidence based practice is the integration of best research evidence with clinical expertise and patient values to facilitate clinical decision making. The operating room multidisciplinary team especially nurse's clinical expertise is based on her/his education, role and responsibilities in the operating department, which means his/her knowledge, clinical skills and attitudes. The operating room nurse must consider the patient's clinical condition, setting and circumstances, the available healthcare resources, and research evidence in his/her daily work.

Introduction
Finding the best evidence means:

- Framing the right question
- Searching for the answer in the right databases
- Appraising the evidence that has been found
- Making the best practical decisions
- Implementing it into practice

Recommendation
Evidence-based practices must consist of all these points to reach the quality necessary for recommendation and implementation.
Developing guidelines should

- assist perioperative staff to make appropriate decisions
- reduce unhealthy variation in practice
- ensure that practice is cost effective

The Appraisal of Guidelines for Research & Evaluation system is to provide a framework to:

- assess the quality of guidelines
- provide a methodological strategy for the development of guidelines
- inform what information and how the information ought to be reported in guidelines

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1.3. EORNA best practice for safe staffing for perioperative departments

Statement
EORNA is dedicated to the promotion of safe outcomes for patients in the operating theatre. EORNA recognizes the need for guidelines for safe staffing levels for operating rooms across Europe.
The most important consideration for patients undergoing surgery is to safeguard them and deliver the best care. To achieve this, we must ensure that we have appropriate staffing ratios of educated specialist perioperative nurses' staff in the operating room.
The perioperative environment includes any setting delivering perioperative care.

Key words
Staff, environment , guidelines, policy, safety

Purpose/objectives
“Staffing ratios are crucial to the overriding principles of the organization to provide quality care, patient safety and staff welfare in the pressured perioperative setting. This edition of staffing for patients in the perioperative environment embraces the changes that have occurred in perioperative care and seeks to provide clear guidance for calculating the safe staffing establishments for perioperative facilities.

Introduction
The formula included in this publication provides a template and calculation guide of the numbers of staff required which, when completed accurately and comprehensively, gives a true reflection of whole time equivalent (WTE) staffing required for your environments. This publication is a guideline but should be viewed as the essential benchmark for perioperative staffing and associated budget for staff resources as the driver, not starting with a budget and then adapting staffing to fit.” (Foreword - Mona Guckian Fisher, 2014)

Recommendation
Staffing for patients in the perioperative environment:

- provides clear guidance for calculating safe staffing establishments
- facilitates effective risk management
- promotes safe staffing
- contains a staffing policy template
- is a valuable tool for perioperative managers”

References

AfPP Staffing for patients in the perioperative setting, 2014. Third Edition. Harrogate www.afpp.org.uk
Available from their website as an eBook at http://www.afpp.org.uk/books-journals/books/book-119.

1.4. EORNA best practice for free movement of professionals (Directive 2005/36/ECF)

Statement
EORNA strongly believes that individuals undergoing invasive surgical and/or anesthetic procedures have a right to be cared for by appropriately qualified staff in a safe supportive environment whilst in perioperative care.

Key words
Care, patient rights, qualified staff, education

Purpose/objectives
Perioperative nurses manage and protect the patient's experience by:

- Supporting the views/beliefs of the patient and acting as the patient's advocate throughout the perioperative care pathway
- Assessing, planning, coordinating, implementing, and evaluating individual patient care
- Promoting and maintaining a safe environment through effective risk management
- Promoting and maintaining professional knowledge and technical skills through education, clinical supervision, reflective practice, and evidence-based practice
- Sustaining awareness of ethical and legal issues

Introduction
Directive 2005/36/EC is essential if the mobility of health professionals is to be enhanced whilst maintaining the quality of professional qualifications. Patient safety and high-quality healthcare are of prime concern in this context.

Recommendation

- The Commission proposed the increase of the entry requirement to nursing education from 10to 12 years. The current evidence report prepared on behalf of the 34 National Nurses Associations members of the European Federation of Nurses Associations (EFN), demonstrates clear support for the Commission proposal. Indeed, 25 Member States of EFN has already set mechanisms in place for ensuring a minimum of 12 years of general educationor equivalent for admission to nursing education for nurses responsible for general care.
- The European University Association (EUA) represents 850 universities in Europe, as well as the national rectors' conferences in 46 countries, recognize Nursing is a field of study in which it is possible to reach PhD and post-doctoral levels.
- EUA is sympathetic to the views of the regulatory, professional, and academic bodies which wish it to become a wholly graduate profession. This would necessitate a training entry requirement of twelve years of general education.
- EORNA recommends a minimum of 12 years of school education to apply to nurse training programs resulting in a Degree in Nursing. EORNA believes this is necessary to assure EU citizens' the rights to safe and quality healthcare in perioperative environments across the Member States.

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3. American Nurses Association (ANA). A Position Paper New York. (update 12/2013)
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1.5. EORNA best practice for post graduate purse education

Statement
EORNA fully supports all initiatives to promote postgraduate nurse education in the perioperative setting to promote patient safety. Continuing professional development (CPD) is essential to enhance nursing practice and advance nursing as a profession (Nursing and Midwifery Council, 2006). In the United States, Canada and the United Kingdom, master's education is seen as the mechanism to this advancement and these courses have been available in many countries for several decades (Gerrish et al, 2003).

Key words
Postgraduate education, master's degree, leaders, leadership

Purpose/objectives
One of the outcomes of the Master's degree is that graduates will develop their leadership and management competencies as well as the ability to work in teams and initiate change in the profession according to the American Association of Colleges of Nursing (AACN) (Drennan, 2012).
In the United Kingdom, approximately 28% of all degrees awarded are at masters' or postgraduate level (excluding PhD) (Department for children schools and families, 2009). In Ireland between 2000 and 2007, the number of master's in nursing degrees awarded increased by 170% (Drennan, 2008).
The development of strands within a Master's in nursing reflects the increasing specialization of the profession and the need to prepare nurses to work in advanced roles in clinical practice, education, or management (AACN, 2011). Currently in many countries, perioperative nurses undertake post graduate education in the form of a Post graduate Diploma in year one with a master's thesis completed in year 2. This is an important step to improve the outcomes for patients and improve the leadership in our healthcare systems across Europe.

Introduction
Graduates from master's in nursing programs are viewed as nurses who will become leaders in clinical practice, health service management, nurse education or advanced specialist practice nurses (AACN, 2011, De Clerq et al, 2011). There is a growing emphasis on incorporating education on leadership at all levels of nurse education (Drennan, 2012).

Two recent reports have promoted the incorporation of leadership competencies into nurse training. In the US, the Institute of Medicine Future of Nursing report (2011, p8) recommended that 'leadership-related competencies need to be embedded throughout nursing education' and that the nursing profession must produce leaders across the system, from "the bedside to the boardroom". It also stated that "to meet the health care needs of the future, nurses need to achieve higher levels of education and be educated in new ways". In the UK report: Frontline Care: the future of Nursing and Midwifery in England (Report of the Prime Minister's Commission on the Future of Nursing and Midwifery in England 2010) noted that nursing leadership is essential to the development of quality healthcare and that education and training in leadership were paramount for all levels of nurse education.

Nurse graduates make significant gains in the development of their professional competencies and outcomes with clinical leadership and management (Drennan, 2012). In this study, graduates who

completed the educational strand scored highest in their ability to communicate in practice and graduates who completed the graduate strand scored highest in their ability to initiate change in an organization. The provision of strands within a master's program that pertain to the clinical, management, education or advanced nurse practitioner appeared to be successful in achieving the programs stated aims (Drennan, 2012).

Recommendation

The process of achieving a higher educational degree develops highly tuned thinking skills that can be applied to senior clinical, managerial, or educational roles within the health services (Drennan, 2012). Fealy et al, (2009) note that the leadership skills and capabilities developed as a consequence of completing a master's degree in nursing apply to professional practice and are necessary to impact on and develop quality care for patients and clients who come into contact with the health service. Watkins (2011) states that the "transference of academic skills to the work environment is undervalued as an outcome from master's education". Nurses in this study were better able to communicate through developing comprehensive strategies and reports. The achievement of MScs influenced personal and professional confidence. Gerrrish et al 2003 state that confidence is linked with improvements in critical thinking and professionalization, while Pelletier et al (2003) link it with improved patient care.

It is important to note that each EORNA member country must work towards the development of postgraduate perioperative nurse education up to and including PhD to develop perioperative leaders for the future. This will result in improved patient outcomes and improved health service management in the nursing profession.
EORNA advocates a postgraduate course (Ex. Master's Level) in perioperative nursing specialization, to increase the guarantee of safe perioperative nursing care[8];

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European Operating Room Nurses Association

Part 2

Patient and staff safety

EORNA best practice for surgical drapes and gowns (Harmonized standard EN 13795)

Statement
EORNA is dedicated to the promotion of safe outcomes for patients undergoing operative and other invasive procedures and the professional safety. EORNA recognizes the need for the implementation of standard processes developed by national, safety or regulatory agencies to prevent the transmission of infection in Europe.
EORNA supports that the standard EN 13795 is the European-wide agreed with a basis for demonstrating that drapes and gowns meet the safety requirements of medical devices legislation.

Key word
Drapes, gowns, standards, infection, surgery, waterproof

Purpose/objectives
Hospitals using drapes (linen or woven) must ensure that their suppliers can meet the safety requirement as set out in the harmonized standard EN 13795. Woven or single use non-woven drapes that comply with this standard are to be used. The consensus is that drapes which meet this standard offer the minimal protection from contamination in the field . Surgical drape materials are a key element in preventing post-surgical infection.

Introduction
Surgical drapes could be made from woven (reusable) or non-woven (disposable) materials. They are assessed for several criteria:

- Protection of health care workers and patients from the risk of surgical site or nosocomial infections
- Comfort
- Economics
- Environmental life cycle analysis
- Jobs (Overcash, 2012).

Recommendation
A comprehensive approach is needed in each health care organization to prevent infection.

- Perioperative nurses are key participants in the selection of drape packs and gowns for use in their perioperative departments.
- As patient advocates, perioperative nurses are most knowledgeable on the range of materials that are available for use in the operating theatre.
- Perioperative nurses understand the requirements for each procedure and are the key stakeholders who can decide if a draping material is suitable for the procedures that are being performed in their institution.
- Surgeons have a role in deciding which product also meets surgical needs but the key consideration for nurses is that the drape material meets the EN 13795 harmonized standard. This is to ensure the ultimate protection for the clinicians and the patients.

The Essential Requirements describe the necessary properties that must be fulfilled for a product to be considered safe and fit for use.

- They cover both product design and manufacture and include general safety, chemical, physical, and biological requirements, microbiological aspects, and labelling.
- The EN 13795 applies to surgical patient drapes, surgical gowns, and clean air suits. The importance of this standard is that it offers better protection for patients and staff. Surgical drapes and gowns must protect against penetration of infectious micro-organisms and body fluids.
- The principle of harmonized standards is that they are agreed collectively by representatives from all EU Member States. A European harmonized standard sets out the technical specifications for manufacturers to ensure their products meet the Essential Requirements of legislation, in this case the EU Medical Devices Directive (93/42/EEC).
- Surgical drape/gown suppliers who want to legitimately claim that their products meet these essential requirements must highlight the fact that they comply with the standard, because the standard allows both companies and end-users to ensuring that the products meet these Essential Requirements. Compliance with the standard allows the conformity to the EU Medical Devices Directive. All products that comply with the standard will bear the CE mark.

The key characteristics of drapes are:

- Waterproof to protect the patient and surgical team from strikethrough from infectious material. There should be resistance to penetration from blood and body fluids.
- All surgical drape materials should be of a quality (resisting holes and defects) for use during surgery.
- Woven drapes should maintain their intrinsic accordance to the EN13795
- Materials used in drape manufacture should have a high fire-retardant property considering the risk of fire in the perioperative setting due to other equipment used in surgery.
- Packaging should indicate to the end user that the product complies with the CE mark.

This European standard is intended to clarify the situation with respect to products and their properties, outlining requirements for users and manufacturers of medical devices . Important considerations for drape standards will be part of the standard i.e. resistance to penetration by microbiological microorganisms, liquids, and particle release.

According to the standard quality assurance for reprocessing of surgical gowns and drapes is critical. The manufacture must use validated processes to prove that the requirements of this European Standard are met. Quality Assurance Systems will be required to give proof of decontamination, disinfection, and sterilization. Specified processes are to be used to maintain the properties of the materials throughout reprocessing. It is the responsibility of the hospital to assure optimal protection of patients and users. Perioperative nurses must ensure that the products they use meet or exceed this standard.
A formal risk evaluation should be done, before the use of this medical devices in certain procedures.

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EORNA best practice for Prevention of sharps injuries (Directive 2010/32/EU).

Statement
As perioperative staff we are aware that following Standard of infection prevention and control Precautions is vital when treating all patients i.e. precautions to prevent exposure should be used for every procedure.
Most of these injuries are preventable with the provision of training, and safety procedures at work and safety engineered sharps devices. As well as healthcare staff, non-healthcare workers are also at risk of injuries from contaminated sharps.
Needle stick injury is thought to be very underreported but can cause blood borne disease in recipients. Managing the risk and reducing the opportunities for injury should be subject to local and national policy.

Key words
Risk, sharps, injuries, prevention, training, standard precautions

Purpose/objectives
The aim of the Directive is to achieve the safest possible working environment by preventing injuries involving medical sharps such as needle sticks**.** Perioperative teams should ensure a reduction in injuries by adopting several safe sharp practices within the sterile field and outside and ensure regular education of all staff who handles sharp items to maintain their vigilance. Safe sharps practice includes elimination of the hazard altogether or using different techniques such as the use of a neutral zone on the sterile field.

Introduction
Risk management and prevention:
The Directive requires that "wherever there is a risk of a sharps injury or infection it must be eliminated". This is the main tenet of legislation.
The Directive sets out a framework to eliminate or, if this is not possible, minimize the risks associated with sharps injuries. These measures include:

- Medical devices incorporating safety engineered mechanisms
- Effective training for staff in their use and disposal
- Effective work processes, including disposal of used sharps items
- A well-resourced and organized workforce
- Local, National and European reporting mechanisms
- A ban on recapping of needles
- All employers are required to do everything reasonably practical to eliminate hazards regardless of where that worker is employed.
- The Directive requires there should be local, national and European systems of reporting in place. Perioperative nurses are required to and are be encouraged to report any accident or incident involving sharps to their employer and/or to the person responsible for safety and health at work.
- Surveillance Systems: All cases of suspected occupational exposure to blood or body fluid from patients infected with HIV, Hepatitis C virus or Hepatitis B virus, and all incidents where post-exposure prophylaxis (PEP) for HIV has been started (whatever the HIV status of the source), should be reported to the appropriate Member State regulator or national surveillance scheme.

- While there is a cost involved in change in practice for safer needle systems, the human and monetary cost of an injury exponentially higher (beyond human harm and suffering).

Culture of safety and good sharps practice

Local policy should focus on reducing the opportunities for sharps injuries, by developing sound practices and all staff identifying where the highest risks are. Preventative behaviors are based on safe practices which must be used by all staff:

- New ways of intervening in the surgical field must be found (Ex. making cuts, injections, dissections, etc.) to reduce the use of sharps and equivalent medical devices.
- Handling of sharps should be minimized so that they are not passed from hand to hand.
- Utilization of a neutral zone on the sterile field where sharps can be placed into a receiver for safe use and retrieval should be implemented . [(4)]
- A disposable device should be used within the sterile field to contain needles and sharps and this should be disposed off at the end of the procedure. [(5)]
- Devices to remove scalpel blades from their handles provide a safer system of work than using an surgical instrument to remove a contaminated blade.
- Use of blunt needles has also been promoted in recent years to reduce sharps injuries.
- Load suture needles using the suture packet to assist in the loading of the suture and use an appropriate surgical instrument to unload the needle. [(6)]
- Isolate all sharps within a restricted area on the instrument table and ensure they do not become entangled or pose a risk to the patient, surgical team, or scrub nurse/practitioner. [(7)]
- Needles must not be re-sheathed, recapped, bent, broken, or disassembled. [(8)]
- Personal Protective equipment should be used by all staff and visitors to operating theatres wherever they are at heightened risk.
- Double gloving should be used according to up to date evidence and recommendations. ([9)]

Disposal

One of the areas where it is known that a higher number of injuries occur is after an intervention has taken place – and the individual has not cleared away their own sharps. Therefore, sound practice should be that everyone using a sharp dispose of it safely in a recognized sharps disposal unit – which should meet United Nations Standards (UN 3291).

- Used sharps should be discarded immediately into a sharps bin by the person generating the sharps waste into a container conforming to current standards [(10)]
- Approved sharps bins should never be overfilled i.e. more than three quarters full or to the manufacturer's line.
- All disposal bins should be positioned close to the point of use
- They should be sealed once full and disposed of according to local policy.
- Used sharps should never be removed from sharps containers – the temporary closure mechanism should be used between uses.

Incident Reporting

Care should be taken to report sharps injuries, so that risks can be understood and avoided in future. It is essential to try to obtain information concerning the serological status of the source patient and should he/she be sero-positive, to determine the viral load and other key pieces of information [(11)]. Decisions about post exposure prophylaxis will be made, and needs to be made quickly, based on this assessment.

Under the Directive workers must immediately report any incident involving sharps to the employer and/or person in charge, and/or to the person responsible for safety and health at work. Existing

procedures for accident reporting involving injuries are to be adapted and revised in conjunction with health and safety representatives.

Where an injury involving a sharp occurs the employer shall:

- Take the immediate steps for the care of the injured worker, including the provision of post-exposure prophylaxis and the necessary medical tests.
- Provide appropriate health surveillance.
- Investigate the causes and circumstances of the incident.
- Ensure systems are in place to record the incident; and
- Provide counselling support for the injured worker. (12)

Immunization

The World Health Organization reports that some countries in EU have elected not to immunize universally against hepatitis B but vaccinate only well-defined risk groups. (13) Healthcare workers fall into the higher risk groups and hepatitis B vaccination should be available for all perioperative staff. Vaccination shall be carried out in accordance with national law and/or practice, including the determination of the type of vaccines. Workers shall be informed of the benefits and drawbacks of both vaccination and non-vaccination. Vaccination must be offered free of charge to all workers and students delivering healthcare and related activities at the workplace. (14)

Training

Workers shall receive training on policies and procedures associated with the prevention and management of sharps injuries during induction for all new and temporary staff and at regular intervals thereafter. Training shall include:

- The correct use of medical devices incorporating sharps protection mechanisms.
- The risk associated with blood and body fluid exposures.
- Preventative measures including standard precautions, safe systems of work (including the ban on recapping/re-sheathing) and, the correct use of sharps bins and disposal procedures.
- The importance of immunization and how to access immunization services.
- The reporting, response and monitoring procedures and their importance.
- Measures to be taken in case of injuries.

Safety engineered devices

The EU Directive recommends that following risk assessment, that safety engineered devices may be provided by the employer as one of the possible control mechanisms. It stipulates that workers should be consulted regarding the procurement of these devices and the following aspects should be noted:

- The device must not compromise patient care.
- The device must perform reliably.
- The safety mechanism must be an integral part of the safety device, not a separate accessory.
- The device must be easy to use and require little change of technique on the part of the health professional.
- The activation of the safety mechanism must be convenient and allow the caregiver to maintain appropriate control over the procedure.
- The device must not create other safety hazards or sources of blood exposure.
- A single-handed or automatic activation is preferable.
- The activation of the safety mechanism must manifest itself by means of an audible, tactile, or visual sign to the health professional.

- The safety mechanisms should not be easily reversible once activated.

Comprehensive user training is pivotal to the introduction of safety-engineered medical devices. Experience has shown that when this is done well, in combination with safer working procedures, the implementation of the safety measures is much more effective.
No intervention can reduce needlestick injuries to zero, but safety engineered devices reduce the risk consistently and significantly. A huge range of independent studies conducted in Europe and elsewhere show that a combination of training, safer working practices and the use of medical devices incorporating safety engineered protection mechanisms can prevent more than 80% of needlestick injuries. [(10)] AORN's Donna Ford recommends that as safety engineering devices are developing rapidly and more are coming on to the device market, that plans should also reflect changes in the technology by making an annual review. [(14)]

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EORNA support the WHO Recommendation - to use the Safe Surgery Checklist

Statement
EORNA fully supports all initiatives to promote patient safety to ensure correct site, correct procedure, and correct patient surgery in the operating theatre. While this document is written as an overarching document for all EORNA members, it is noted that all countries have different systems in place to manage the surgical patient's journey; therefore, this document is written as a guidance document for the use of the Safe Surgery Checklist.

The World Health Organization (WHO) devised this initiative by using a team of international experts, from a variety of clinical backgrounds. A large-scale study of the checklist was performed, in eight international hospitals, from October 2007 to September 2008. The data demonstrated a reduction in patient deaths of 0.7%, from 1.5% down to 0.8%. There was also a large reduction in major patient complications, dropping from 11% to 7% (Haynes et al, 2009).

Key words
Checklist, sign in, time out, sign out, patient safety

Purpose/objectives
This practice outlines the WHO requirements for patient identification and verification in the form of the Safe Surgery Checklist with Briefing, Sign In, Time Out, Sign Out and Debriefing procedures to be conducted before and after any invasive or surgical procedure that exposes patients to more than minimal risk.

Introduction
The checklist is a tool to ensure safe patient care during invasive procedures. These five stages are important in ensuring safe surgery for all patients. It is a mechanism for the whole surgical team to agree that surgery was completed, and went well, whether the patient requires any specific care and whether there are any anticipated post-operative problems. Potential consequences of not being involved in the Safe Surgery Saves Lives

Initiative are a wrongly identified patient; wrong procedure being performed in the wrong site or side; the surgical team not being prepared; adverse reactions occurring that may have been avoided if verbalized and identified prior to skin incision.

Recommendation
The Briefing stage is where the perioperative team meets to discuss the patients for the day and to streamline processes for the safe care of patients. At this point any clinical issues are discussed and processes put in place to ensure patients arrive in surgery when any further clinical tests are complete. This also ensures that all equipment, implants, or anything that could cause an issue during the day are discussed and the problem solved.

Sign In involves the whole surgical team the anesthetist and the anesthetic nurse to perform several checks for clarity regarding patient identification, type, site and side of procedure to be performed. Patient name and procedure is verbalized, and agreed, for the whole team, the anesthetist confirms the presence or absence of a suspected difficult airway or aspiration risk and the availability of equipment and assistance. It must be confirmed that all necessary equipment is both present and checked for function.

Timeout is performed immediately prior to skin incision. All team members stop there tasks, identify themselves, the patient is identified a second time, along with the expected procedure and side and site of procedure. Any potential critical events are identified, and it is checked that any prophylactic antibiotics are administered.

Sign Out is performed immediately following the end of the procedure. The procedure is stated and checked that it was the correct one performed. Instrument and swab counts are confirmed as completed and correct and numbers specimen and ID labelling is confirmed as correct. Any problems or critical events/concerns that may affect the patient's post-operative outcome and recovery are identified. Any post-operative instructions are stated at this point. If Sign Out is missed, important post-operative instructions may be forgotten, unusual blood loss may not be reported, or there may be an error in instrument or swab counts.
Debriefing occurs finally to discuss the actual procedure process to indicate if anything could be improved for the next time, and that, post-operatively, all safety checks are complete.

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EORNA best practice on prevention of inadvertent retained surgical items

Statement
A surgical safety counting procedure, SSCP, is required to ensure patient safety and accountability of all items used in a surgical intervention (soft goods, instruments, sharps, and miscellaneous items). The objective is to prevent the unintended retention of surgical items in a surgical patient's body. The occurrence of RSI (inadvertent retained surgical items) is totally considered as preventable.

Key Words
Perioperative nursing, surgical count, surgical count procedure, surgical count process, patient safety, retained surgical items, surgical instruments, surgical sponges

Purpose/objectives
The purpose of the recommendation is:

- to provide guidance to the operating room nurse to perform a proper quantitative and qualitative procedure of sterile surgical items (soft goods, instruments, sharps and miscellaneous) relative to a surgical intervention, so that the patient is safeguarded.
- to provide guidance to the operating room nurse to act and cooperate with the surgical team in a safe and proper manner, so that the occurrence of an inadvertent retained surgical item in the surgical wound is prevented.

Introduction
Surgical safety counting procedure is an essential procedure for patient safety and well-being (AORN, 2016; Joint Commission, 2013; ORNAC 2011; WHO, 2009).
To accidentally leave a foreign object in a patient's body during surgery is a mistake that is rare, but it is serious and if it happens it may result in serious complications to the patient, including reoperation to remove the item, and risk of; infection, bowel perforation, fistula, or even death (Stawicki et al., 2009). It also has negative consequences, legal, financial and others, to the health care professionals and the health organization (Hariharan & Lobo, 2013). Factors that affect sterile surgical equipment being left unintentionally may be acute surgery, unexpected surgical procedure change, extensive bleeding, and instrument/scrub nurse replacement during on-going surgery, multiple surgical team involved, prolonged and complicated surgery, among others (Gawande 2011; Gawande, Zinner, Studdert & Brennan, 2003).
"Counting is a human process that's very prone to error, especially in a busy environment where multiple things are happening simultaneously" Gail Horvath, a patient safety analyst of the ECRI (Emergency Care Research Institute - https://www.ecri.org). ECRI emphasizes the need of written standards and guidelines for safe counting, which are followed by operating room professionals of Health Services Organization. ECRI also states the need of a culture that promotes team accountability and nurses to speak up.

Responsibility for the surgical safety counting procedure
The responsibility, the role, or the function of an operating room nurse in Europe seems to vary depending on in which country work and were you have received the education to become an operating room nurse.
The responsibility for each role must be defined by each country in Europe because it varies today, 2019. Anyhow, the Surgical Safety Counting Procedure, SSCP, must be performed by one of the persons (nurses, others) responsible pre- per- and postoperatively to ensure patient safety.

The problem

Inadvertent retained surgical items, RSI, are mostly detected immediately after a procedure, after a fluoroscopy, X-ray, during routine follow-up visits or from patient complaints about pain or discomfort. The most common location for RSI, are in the abdomen and pelvis after surgery, and sponges, are the items most commely left behind (Gümüş et al., 2012).

Unintended retained surgical items associated with surgical procedures may cause serious complications for patients such as:

- Adhesion
- Encapsulation
- Infection
- Abscess
- Obstruction
- Fistula
- Perforation
- Pain
- Unnecessary suffering
- Vascular complications as: Thrombosis, Embolization
- Arrhythmia
- Tamponade
- Perforation
- Death

Factors that cause items to be left unintentionally can be:

- Incorrect count
- Interrupted counting/security control
- Distractions, as technology, electronic activities, patient care activities, behavioral activities, the physical environment
- Long surgical procedure
- Emergency surgery
- Unexpected or unforeseen change in operating method/technique
- Unexpected change in the patients' health/vital functions
- High Body Mass Index (BMI)
- Extensive bleeding, more than 500 ml
- Relief of operating room nurse
- More than one surgical team involved
- Extracted or complicated surgical procedure
- Occurrence of a safety variance during the surgical procedure
- Fatigue / long working hours
- Surgery performed during evenings, nights, or weekends
- False security at radiology control checkup
- The absence of policies and procedures
- Failure to comply with existing policies and procedures
- Problems with hierarchy and intimidation
- Failure in communication with physicians
- Failure of staff to communicate relevant patient information
- Inadequate or incomplete education of staff

Recommendations
EORNA recommendations are based on literature reviews and on the WHO Checklist for Safe Surgery. Surgical safety counting procedures, SSCP, are to be as followed:
The SSCP, surgical safety counting procedure should be performed:

- Before the surgical procedure starts
- When a new item is added during the surgical procedure
- Before closing a cavity within a cavity
- Before wound closure begins
- Final count should be performed after skin closure and before the patient leaves the operating room
- When suspected discrepancy
- When permanent relief of the instrument/scrub nurse or circulating nurse or both

Special Observations

- Systems for safe handling of sterile instruments, sponges, peanuts, and other materials should be available in relation to surgical interventions.
- Unsterile instruments used in the operating room for purposes other than for surgery should be clearly labeled to be distinguishable from surgical instruments.
- Waste and laundry must remain in the operating room until the final procdure, SSCP, is completed.
- If a surgical retained item is metallic there will be a risk if/when a patient has a Magnetic Resonance imaging procedure (MRI). The heating metallic item may damage internal tissues.
- If an instrument or an item or a part of an item is left in the surgical wound, the surgeon should inform the patient or the patient's representative. This should be documented in the patients' health record.
- At exceedingly rare occasions instrument counts may be waived for surgical invasive procedures in which accurate instrument counts may not be achievable or practical. When instrument counts are waived, intraoperative imaging will be performed before the patient is transferred from the operating room, unless this puts patient's safety at risk (AORN, 2016).

Preconditions for the surgical safety counting procedure, SSCP

- At surgical procedures/operations, the operating room nurse, circulating nurse or the instrument/scrub nurse depending on regulation per country) is responsible for prescribed safety controls of surgical items. "Soft goods" such as sponges, "peanuts" and other non-woven or cotton gauze materials must be marked with sequentially numbered sponges, bar coding or radiofrequency identification (RFID), which can be traced (Murphy, 2019).
- All instruments in a set must have a table of content, a list of all instruments. The instrument sets should be standardized as recommended by WHO Guidelines (2009) and instruments that are not routinely used should be removed from the set and the list of content (the fewer instruments, the easier and faster it is to perform the surgical safety counting procedure, and it is efficient / effective for the sterilization process). If, during an operation, deviations from current routines have occurred, the surgeon is responsible for carrying out safety control measures and this should be documented by both the operating room nurse and the surgeon.
- A surgical safety counting procedure, SSCP, includes a quantitative and a qualitative safety control preoperatively, intraoperatively (immediately before wound closure) and directly after the surgery, postoperatively. The quantity stands for the number of items in a set that must be in accordance to the list of content.

- Qualitative safety controls include inspection and the function of the instruments, bioburden materials, completeness of the items, and without rust and cracks.
- The SSCP should be performed loudly by the instrument/scrub nurse and the circulating nurse together ; the rest of the team, must be silent and collaborative . The operating room nurse should count and record the number of sponges, peanut's etc., and if the content of the instrument set conforms to the instrument list, and check that all material is intact and sterile.
- The SSCP shall be made without interruption and time shall be allocated for this routine. Distractions should be minimized during the procedure.
- Waste should not leave the operating room until after the surgical procedure and when the person responsible for the SSCP, gives permission.

Anesthesia professionals

- Surgical items and anesthesia items must be held separate including waste, depending on the risk of discrepancies when the safety surgical counting procedure is performed per- and postoperatively.
- Anesthesia professionals are not allowed to use any sterile items from the instrument set, they shall have their own marked instruments and only for use by anesthesia professionals. Anesthesia professionals shall communicate when throat packs and similar devices are inserted in the patient's oropharynx and inform when the items are removed from the patients' throat or mouth.
- Remove any items or equipment used for anesthesia procedures, such as clamps and needles used for central line placement and dressing gauze before the skin disinfection procedure and the sterile draping starts or when surgery starts.
- Anesthesia professionals may assist in retrieving and opening sterile items, for example suture or sponges, and the operating room circulating nurse must be informed of this. Opening extra items/equipment without proper information and documentation will lead to discrepancy at the end of the procedure.

Soft goods

- New technologies to facilitate the tracking of sponges, "peanuts" etc. are constantly under development, for example radiofrequency identification (RFID), X-ray detectable threads, bar coding and more. Sponges and "peanuts" used during surgical procedures should always have a traceable system in each individual item. Soft goods should be packaged in a standardized system such as 1, 5 or 10/package. Every package should be marked with an individual number on two receipts.

Preoperative, surgical safety counting procedure (SSCP)

A preoperative counting procedure will be a baseline for the numbers/quantity check of instruments and materials and a baseline of the inspection of the instruments and materials/quality check.

Sponges, "peanuts" etc.

- Both receipts/identification numbers (2) of the package should be separated, one is given to the circulating nurse and one is kept sterile, at a special place at a back table, not on the Mayo stand.
- Each sponge should be fully separated, counted and the traceable marker (i.e. x-ray detective thread, RFID etc.) shall be checked by the instrument/scrub nurse and circulating nurse. The count is carried out audibly. The sponges should not be cut into smaller pieces.

- Each "peanut" should be lifted out from the package and counted, and the traceable marker shall be checked by the instrument nurse and circulating nurse. Then replace the peanuts back in the package or in a special box on the back table. The count is carried out audibly.
- In the event that a non-standardized number of sponges, "peanuts" etc. is found in the package (e.g. 6 or 4 instead of 5 sponges, 9 or 11 sponges instead of 10) the package should be sealed in a bag, marked and isolated and taken out from the operating room. This should be brought up to the management of the Operating Room Department and notification of medical devices non-compliance must be done.
- Sponges, aimed for the surgical procedure with traceable markers on, should not be used outside the surgical field (e.g. by anesthetists).
- If an item falls from the surgical sterile field, immediately inform the instrument/scrub nurse or the circulating nurse. Dropped items need to be appropriately managed to ensure that they are properly accounted for.

Instruments and needles:

- An instrument set must have an individual number inside the sterile set and outside the package for traceable function. A table of content/a list of all instruments/items must be available for safe counting procedure.
- The instruments should be in accordance with the instrument list.
- Additional sterile instruments may be opened and used during the operation; the same safety counting procedure shall be performed.
- Needles will be inspected and situated at a safe place or on a needle holder/counter for not causing any injury.
- In the event, that the instruments in a set are not correct according to the instrument list, or are inaccurate or incomplete, the whole instrument set should be taken out from the operating room. New set of instruments should be brought in and a new safety counting procedure must be performed before the surgery starts.
- Defective instruments should be removed, and documentation must be done according to local routines or regulations.
- If bioburden will be discovered the whole instrument set should not be used. New set of instruments should be brought in.
- In case of breakage/dysfunction of an instrument or an item, the surgeon must be informed, and the item should not be used during surgery.
- All instruments, needles, sponges, and other equipment used should be documented in the patients' health care record or equivalent, as a matter of trassability, depending on each country's laws and regulations.

Preoperative SSCP, surgical safety counting procedure

During the WHO (2009) Surgical Safety Checklist phase TIME OUT; the instrument/scrub nurse or the circulating nurse shall verbally confirm to the surgical team members that the instruments and sponges etc. are sterile and are correct according to number and function.

- When a new package of sponges is added to the surgical field, it should be performed as in the preoperative phase; each sponge should be fully separated, counted and the traceable marker shall be checked by the instrument/scrub nurse and circulating nurse. The count is carried out audibly. This should be documented in the patients' health care record.
- A new package of "peanuts" is added in the sterile field; the same routine as in the preoperative phase shall be performed by the instrument/scrub nurse and circulating nurse, and to be documented in the patients' healthcare record.

- If one or more extra instruments or supplies are added during the surgery, it/they should be counted by the two nurses and be documented in the patients' health care record .
- Sponges, directly after being used in the sterile field, are placed in a safe system for a visible assessment, for example a "pocketed sponge bag system" and each sponge is placed in a structured way i.e. from bottom to top or "five in a row" depending on the system.
- One sponge shall be placed in each pocket of the pocketed bag system and placed so the nurses can visualize the traceable mark.
- Miscellaneous items such as needles, guide wires etc. should be counted, as same as, for the instruments and sponges. When opening a "needle–letter", the package will be saved in a systematic order at the back table and the used needles should be placed in a sharp container.
- During or when closing after a laparoscopic surgery a magnetic tip probe may be of advantage to seek for lost miscellaneous items such as small needles. Needles that are minor than 10 mm are difficult to locate in radiographic screening.
- If an item is broken when returned from the surgeon this should be announced loudly and a search should start immediately, otherwise it will be risk of extended surgery and longer in time and delays may occur. When an item is missing, the instrument/scrub nurse should reorganize the sterile field to get an overview, the circulating nurse search in the operating room, and the surgeon perform an exploration in the surgical wound in a methodological way or order an intraoperative radiograph until the lost item is found. This is depending on the patient's health status and condition.
- Before closing the surgical wound the surgeon are responsible to remove the sponges, instruments, and other items from inside the patients' body, and the SSCP should be performed with no interruptions or distractions and be performed thoroughly.
- At the counting procedure (and inspection of instruments for completeness - a qualitative safety check) each item should be separated and the instrument/scrub nurse and circulating nurses counts aloud. If the SSCP is interrupted, it should restart.
- The surgeon should perform a methodical wound exploration both visible and by touching before closing the surgical wound, for items that still may be in the wound (AORN, 2016).

Safety counting procedure is performed by reading through the table of content consecutively, one instrument after the other, and compare with the instruments used during the operation. The SSCP of the instruments includes inspection and function of each. Inform the surgeon of the result of SSCP, immediately when the counting procedure is completed.
Every item in the instrument set must be written on the table of content or at the board or in the count sheet (depending on what system is used) before proceeding the counting to the next item.

In a case of bilateral procedures (i.e. bilateral inguinal hernia repair), sponges, sharps, instruments, and miscellaneous items must be completed at each incision closure (ORNAC, 2011).

Counting procedures should not be performed during critical phases of the surgical intervention, including time-out periods, critical dissections, phases of confirming and opening implants, during the patient's induction and emergence from anesthesia, and handling of specimens (AORN, 2016).

Relief of professionals
In case of permanent relief during surgery of the instrument/scrub nurse or the circulating nurse a structured handover must be given about the patient, surgical procedure, the process (what the surgeons have done and what the next steps are in the procedure) according to SBAR (Randmaa, Mårtensson, Leo Swenne & Engström, 2014, WHO 2007). The verbal report includes also a complete

count of the instruments, sponges, used material, implants, equipment and specimens etc. or alternative is a new updated TIME OUT may be held for the whole surgical team to be aware of the actual situation. This count result should be documented by the nurse relieved.

Short duration relief of the instrument/scrub nurse or circulating nurse, the counting should be complete of the items in use and a handover given by a structured model as SBAR.

Postoperative Surgical safety counting procedure (SSCP)
During the WHO (2009) Surgical Safety Checklist phase SIGN OUT; the instrument/scrub nurse and circulating nurse gives a clear verbal statement of whether the final SSCP was correct to the surgeon and surgical team members (WHO, 2009). Meaning that the number and completeness of instruments, sponges, needles etc. corresponds to what has been given and used during surgery. The sharp container must be closed and sealed properly for avoid any injuries.
Immediately after surgery the safety counting procedure is performed by reading through the table of content consecutively, one instrument after the other, and compare with the instruments used during the operation. The SSCP of the instruments includes inspection and function of each. Inform the surgeon of the result of SSCP, immediately when the counting procedure is completed.
Every item in the instrument set must be written on the table of content or at the board or in the count sheet (depending on what system is used) before proceeding to counting the next item.
Sponges, peanuts etc. should be counted in the "pocketed sponge bag system" for assessment of what was taken up and the two individual numbers/receipts should match each other. Sponges that have not been used should be pocketed in the pocketed sponge bag system for checking that any sponge is missing.

All items should remain in the operating room until the final count has been performed and is completed (WHO 2009).
The instrument/scrub nurse and/or the circulating nurse give permission to remove any items from the operating room. All items should be removed from the operating room after the patient has left the room for preventing any count discrepancies for the next patient who will enter the operating room (Steelman & Cullen, 2011)

Wound dressing
Wound dressing should be withheld from the sterile field until the surgical wound is closed.
Sponges with an imaging such as x–ray detectable thread, bar code, radiofrequency ID should not be used as a wound dressing.
If a packing or fabric bind is used i.e. after nose surgery or in the vagina after prolapse, this must be with material other than a surgical sponge with imaging detective marker on. This should be documented in the patients' record as a wound dressing.

Therapeutic packing
When sponges are used as a therapeutic packing in a cavity within the patient and the patient leaves the operating room a standardized procedure must be established and the content in the documentation must communicate where the sponges are located.
Under special circumstances, (damage control surgery) the surgeon may decide that the patient needs a therapeutic packing left in the patient's surgical wound. In this case, the number and types of items placed in the surgical wound must be documented in the patient's healthcare record. A clear handover according to SBAR must be performed to the next caregiver in the intensive care unit.

When the patient is returned to the operating room for a subsequent procedure or to remove therapeutic packing, the surgical team should determine from the record the number and type of radiopaque soft goods that should be removed. The type and numbered of the removed radiopaque soft goods must be documented in the patients' healthcare record. The surgeon should inform the patient or patient's representative of any surgical soft goods purposely left in the wound at the end of the procedure and the plan for removing these items. (AORN, 2016)

Documentation

All used equipment, such as instruments, needles, sponges, and other material should be documented in the patients' health care record. This is for items to be traceable if something is missing. Names and position of the persons who performed the SSCP, surgical safety counting procedure should be recorded, and the result of the count should be noted as correct or incorrect. If a discrepancy was found and an action taken, this should be documented in the record (AORN, 2016; WHO, 2009)
If, a surgical safety counting procedure has not been conducting relative to surgery, the reason must be documented in the patient healthcare record (WHO, 2009).

If defective, broken, or fragmented instruments or items are detected during the qualitative control, the item should be removed and documented according to local routines or regulations. In particular, personnel in the sterilization department must receive this information.

Afterword's

The, surgical safety counting procedure (SSCP), is performed differently in countries around Europe depending on regulations, traditions and routines, but the members in the surgical team must be sure that nothing is left behind, and that the patient had received the best possible care.
Organizations should establish a standardized approach for prevention of unintended retained surgical items procedure.

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European Operating Room Nurses Association

EORNA best practice for safe positioning of patients

Statement
The perioperative team will ensure that the patient is safely positioned considering the anatomical alignment and physiological functioning of the patient during their surgical procedure. Assessment of the individual patient will include their specific needs, as well as those of optimum access for both the surgical and the anesthesia team. The needs of the patient will include their dignity, comfort, warmth, and safety.

Key words
Position , transfer, injury, fail, harm, teamwork, safety

Purpose/objectives
The safe transfer and actions required to position the patient safely are actions which need to be carefully planned with appropriate numbers of staff available as well as the correct positioning equipment to reduce the staff and patient injuries. Perioperative staff need to be aware of potential injuries they may cause to patients should they fail to position the patient correctly and the techniques for prevention of inadvertent harm.

This issue has important consequences for the manual handling of patients and for safe positioning of patients on the operating table. Traditionally, many patients must be lifted or maneuvered into the correct position for surgery without the use of hoists. This place a lot of physical stress on perioperative team members moving the patient.

Introduction
Safe, appropriate positioning of the patient for surgery requires knowledgeable practitioners being able to assemble the correct equipment for the patient and their procedure, as well as making a risk assessment of the patient for their individual specific needs. The required outcome is a patient whose surgery may proceed with optimum access for the surgeon, access by the anesthetist to the airway, to IV lines and monitoring equipment as well as a patient who has no adverse outcomes or injuries caused by their position on the operating table.

Proper positioning reduces the risk of pressure related damage to nerves, muscles, skin, and joints. The anesthetized or sedated patient is unable to communicate if they have been placed in a compromising or dangerous position, hence a proactive approach should be taken to prevent the deleterious effects of poor patient positioning. (1) Harm may be caused which results in paranesthesia, deep vein thrombosis or compartment syndrome all of which may have lasting, potentially catastrophic effects for patients.

The three critical elements of safe patient positioning are planning, knowledge and teamwork.

Obesity is an increasing problem for healthcare systems across Europe. Hospitals and particularly operating rooms must identify the maximum patient weights which their operating tables and patient trolleys are designed to support. A study undertaken for the UK health and safety executive in 2007 (2) identified that specialist equipment for bariatric patient management was least likely to be found in theatre and X-ray. Only 42% of acute hospital organizations had a policy for managing obese patients, whilst it was estimated that more than 25% of patients will be obese.

Recommendation

Patient assessment

The perioperative team will assess the patient for pre-existing conditions which may affect their mobility, nutritional status, circulatory efficiency, neurological compromise, or other conditions which may affect their general health, for example their skin condition and integrity .

The patient should be reviewed to identify whether any intra-operative factors will impact their safety, such as length of surgery and planned position for surgery together with all their individual risk factors. Additional precautions may be necessary when positioning special patient populations (e.g. neonatal, elderly, malnourished, morbidly obese patients; those with chronic diseases; patients with existing pressure ulcers) to reduce the risk for integumentary (skin), respiratory or cardiovascular compromises and nerve impairment. (3)

The shearing and frictional forces which are recognized as contributing factors in the development of pressure ulcers require that the perioperative assessment shall take a number of different factors into account, to identify the patients at highest risk, so that the risks may be reduced and mitigated as far as possible.

Guidelines from the European and US Pressure Ulcer Advisory Panel (4) have singled out patients in the operating room as being at particularly high risk, as they cannot move and may be static for extended periods of time. They urge perioperative staff to refine the risk assessment of individuals by examining additional factors that are likely to occur which may increase the likelihood of pressure ulcer development. They specify length of operation; increased hypotensive episodes intraoperatively; low core temperature during surgery and reduced mobility on day one postoperatively. They suggest that appropriate responses are to use pressure redistributing mattresses on the operating table, for all individuals in the higher risk brackets; to position the patient in such a way as to reduce the risk of pressure ulcer development, to elevate the heels completely from the operating table mattress, so that the patient's weight is evenly distributed along the length of their calf, and with the knee in slight flexion. It is suggested that attention is paid to pressure redistribution prior to and after surgery, ensure the patient is in a different position pre-operatively and postoperatively to that adopted during surgery.

Advice issued by the National Collaborating Centre for Nursing and Supportive care in 2003 suggested that there was a lack of evidence on which form of pressure relieving overlays are the most effective for perioperative use but they recommended that operating rooms ensure patients at higher assessed risk should be placed on pressure relieving mattresses before, during and after surgery. (5) There are no pressure relieving mattresses on the market for surgery longer than 2 hours.

Aids and Equipment

To reduce the risk of musculoskeletal injuries to staff who transfer patients from trolley to operating table, there are many different aids to reduce manual handling loads, which have been devised. Sliding pads and sheets as well as rolling devices exist to assist the team to transfer the patient. The important aspect of being trained to do this appropriately is to ensure that the patient receives no skin damage from friction or shearing, as they are moved. And, that staff do not injure themselves during patient transfer. Staff have access to manual handling training and should be able to undertake this as part of hospital induction programs and as required, at least annually.

There are many general and specialized positioning devices, made of covered foam and gel. They have been shaped for every possible extremity, position, and size of patient. The aim of using positioning equipment is to use that witch has been designed to redistribute pressure which decreases the risk of positioning injuries to patients. (6) New devices are emerging which redistribute pressure effectively. Theatre personnel as part of their planning process, need to ensure that the range they require for their patient, is available in the room, when the patient needs to be positioned.

Back injuries are common in nursing and according to European data the work-related accident rate in the healthcare sector is 34 % higher than the EU average [7]. In addition, the sector has the second highest incidence rate of work-related musculoskeletal disorders (MSD), after construction. A study by Estryn-Behar et al in 2003 (8) collected data from more than 30,000 nurses in ten European countries and found musculoskeletal disorders with a medical diagnosis were reported by more than 25%.

Manual lifting and other patient handling tasks are high risk activities that can result in musculoskeletal injuries, especially in emergency situations. Risk assessments must be carefully undertaken, and appropriate training and equipment be available.

General positioning principles
The patient is often not transferred or positioned on the operating table, until after they have been anesthetized. They are therefore unable to verbalize whether they are comfortable or not.

The team will assign a lead for the transfer – often the anesthetist, who will confirm that everyone is ready. It is usual in local policy to determine which member of the team is responsible for managing the head and the airway of the patient, during the movement. Manual handling training dictates that the call to move is often "Ready steady slide/roll" and is recommended as opposed to calling "One, two, three" as staff often have moved before three is called. This is to prevent staff injuring themselves or the patient.

The movement will use the transfer device of choice in the hospital and on which all staff will have been trained. It is critical however critical, to also have enough staff available, as patient obesity becomes more of an issue in Europe. There should be at least 4 staff available to safely transfer the unconscious patient.

Once the patient has been transferred to the operating room table, they must never be left unattended. Positioning devices will be used carefully to ensure that the patient is securely held in the appropriate position without being under any specific pressure or limbs being unnecessarily tightly held. All positioning is completed in cooperation and communication with the anesthetist to ensure airway and all access devices are patent, body alignment is maintained throughout, and head, extremities and joints are supported.
Correct and appropriate padding is used to distribute the pressure evenly over a larger surface area and protect all bony prominences and superficial nerve areas from injury. The limbs are supported in the neutral or natural position to prevent neuromuscular strain and skeletal damage. The team will be aware throughout the process of the patient's natural body alignment together with the application of principles of ergonomics.

The patient's skin condition should be assessed as they are positioned and documented in the care record.
The patient's dignity will be preserved as far as possible during the transfer, by reducing exposure and thus also reducing possible heat loss.

Staff will be aware always of the potential for damage to the patient's skin from friction burns, as well as extra-ocular or corneal damage to their eyes, and bruising to their breasts or genitalia. Care will be taken to ensure this damage is minimized or avoided.

Patient's limbs which need to be protected and secured using protective padding or special devices designed for the purpose (e.g. ulnar nerve protection devices which can be padded as well as secured using the operating table mattress.) Pillows and headrests are crucial for stability of the airway and comfort for the patient.

Heels must never rest on the mattress/table but will be raised safely and protectively by heel pads designed for the purpose.

Hands will be protected, depending on the surgical access required, on an arm board where their palm will be facing upward, or tucked by their side, not too tightly, in a neutral position. The ulnar nerve must be protected while the patient's arms are by their side by ensuring that the elbow is not touching any metals and loosely positioned.

The patient must not meet any metal on the operating table in order to reduce the risk of diathermy/electrosurgery burns. [9] The use of metal retractor bars during surgery should be assessed due to the risk of injury to patient's upper limbs, especially if the patient is large and compression occurs due to pressure from the bar.

Specific positions

The multidisciplinary team will be aware of the specific positions which may be used for particular surgical approaches, ensuring that all the equipment required is available to support that position, as well as the anatomical implications of the position and the physical limitations of the patient. [10]

Patient injury

There are several mechanisms which are recognized to be the cause of patient injury. These include stretch, traction, compression, generalized vascular ischemia and metabolic derangement e.g. diabetes and atherosclerosis.

Compression may be caused by pressure on a nerve by a bony prominence i.e. ulnar and peroneal nerves. Traction and stretch can occur to nerves which may be long and run over several structures, i.e. brachial plexus and sciatic nerves and ischemia can occur when the vascular supply to neural tissue is interrupted by compression. The same mechanisms also contribute to the development of pressure ulcers. [11]

However, it is sometimes the positioning devices themselves which can be the cause of injury. Special attention should be paid to genitourinary or gynecological surgical patients who need to be positioned in a lithotomy position or using Lloyd Davis stirrups for surgical access. Both these positions have resulted in compartment syndrome and harm to patients.

Ocular injury and corneal abrasion are also patient injuries that may occur during transfer and positioning . Due to drying of the natural tears, the vulnerability of the cornea to severe abrasion exists and to reduce the risk of damage, the eyes should be closed and protected with eye pads and continue vigilance. Horseshoe headrests should not be used for prone patients as they have been implicated in nearly all cases of direct eye pressure damage in the prone position. [12]

Documentation

Documentation of care delivered should ensure that appropriate attention is paid to recording of the position and positioning devices used for the patient during surgery.

Skin condition is assessed prior to the procedure, during positioning if possible and checked post operatively. This should also be documented and handed over to the recovery nurses.

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European Operating Room Nurses Association

EORNA best practice for maintaining normothermia

Statement

Perioperative hypothermia has adverse outcomes for the patient and can be largely prevented by actively warming the patient before, during and after surgery. Operating rooms should have a system in place for managing the potential risk of hypothermia in patients undergoing surgical procedures.

Key words

Hypothermia, risk, anesthesia, warm, blood transfusion, induction

Purpose/objective

Perioperative hypothermia is a side effect of anesthesia, which blocks the thermoregulatory mechanism in the hypothalamus. The patient is also subjected to cold rooms, exposed skin surfaces and long periods of immobility during surgery. Outcomes for the patient are longer times in Post Anesthesia Care Unit/ recovery unit and hospital, a greater likelihood of getting a surgical site infection and pressure ulcers. Additional side effects are poor drug metabolism, increased cardiovascular post-operative incidents and an increased blood loss and possible need for blood transfusion. The elderly and the young i.e. neonates are at highest risk. Patients should be informed before they come into hospital to bring sufficient clothes to keep them comfortably warm.
(1), hypothermia is defined as a core body temperature of less than 36°C. [2]

Introduction

Adult surgical patients are at risk of developing hypothermia at any time during the surgical pathway. . When the patient is prepared and waiting for their surgery on the ward or admission area, is the time when they should first be assessed and kept warm if they do not 'feel comfortably warm'. When they are transported to the Operating Suite through the hospital corridors is the next opportunity for them to become cold and in the anesthetic room. This period may be called per-operative care and assessment by regular monitoring and prevention measures should be taken.

Factors which contribute to perioperative hypothermia

Thermoregulation may be impaired by a variety of perioperative factors, which have been suggested as possible causes. These include agents used to induce anesthesia [2], exposure of a large body surface to the typically low temperature and humidity in the operating room environment [3], administration of cold IV and lavage fluids, and evaporation from surgical sites. [4]
Hypothermia can be deliberate or inadvertent (unplanned). Deliberate hypothermia may be induced for medical or surgical reasons such as in cardiac or neurosurgery, when it is beneficial to reduce metabolic activity.(5) Patients may have underlying disease which increases the chance of them becoming hypothermic, such as peripheral vascular disease and diabetes. In addition to age related hypothermia, patients injured traumatically or patients with extensive burns are also at higher risk[6] . Studies have shown 21-50% of trauma patients are likely to become hypothermic. [7]. However, the vast numbers of patients having elective or emergency surgery are at risk of preventable, inadvertent hypothermia.

Induction of anesthesia

The patient's core temperature can decrease to 35°C or below during the first 30-40 minutes of anesthesia, because of the anesthetic induction agents on the hypothalamus and a redistribution of body heat from core to peripheral tissues.

Recommendation
The patient should be kept warm during induction of anesthesia. Active warming measures may be taken, such as the application of warm blankets over the patient, warming mattresses or forced air warming. (8) Baseline observations during induction of anesthesia should include the patient's temperature, and temperature measurement should continue to be documented throughout surgery, every 30 minutes.

Intra-operative care
Every means within the team's control should be used to ensure that the patient does not become hypothermic during surgery. This may mean increasing the temperature of the operating room, whilst the patient is prepared and draped, when it may have been reduced for team comfort. Extra warm blankets may be used for the patient. There are many different technologies available to keep patients warm including convection mattresses, forced air warming, water mattresses etc. Should be used to keep the patient warm. Recommended practice suggests that patient warming should occur for all patients having surgery for longer than 30minutes. [9]

Fluids such as IV fluids and blood should be warmed to 37°C using a fluid warming device. Lavage fluids should also be warmed in a cabinet to between 38-40°C, before being used in the patient. Other fluids such as those used during arthroscopy, cystoscopy and urological procedures should be specifically warmed, so as not to induce hypothermia in the patient. [10]

Post-operative care
The patient's temperature should be measured and recorded on admission to the post anesthetic care room and every 15 minutes thereafter. They should not be discharged from this area until it is 36°C or above. Patients should continue to be actively warmed if they are not comfortably warm. [11]
Hypothermia is the most common cause of post-operative shivering [12]. Shivering can increase oxygen demands and can also cause a strain on the cardiovascular system. It can also be the cause of patient distress [13].

Consistent means of temperature measuring should be employed throughout the patient's surgery and post-operative care, so that the measurements are comparable and consistent. Maintaining normothermia must be the goal of all perioperative teams, for management of all their patients

Pediatric and neonatal patients
It is advisable to warm and humidify anesthetic gases used on this age group of patients. AORN Recommended Practices identify a temperature for the operating room to prevent hypothermia in infants and neonates, of 26°C – although this is not repeated elsewhere. [14]

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EORNA best practice for safe management of tourniquets

Statement
Tourniquets are used on limbs to occlude blood flow and thereby achieve a bloodless surgical field. They are advantageous to the surgeon and the patient but need to be managed with caution as they can be hazardous. Biers block in regional aesthesia practice also uses tourniquets and can equally be hazardous. Perioperative staff should be clear about the risks with tourniquet use, reduce opportunities for harm to occur and work collaboratively with other team members to reduce the risk of potential injury caused using tourniquets.

Key words
Tourniquet, injuries, risk, safe, orthopedic, policies

Purpose/objective
Perioperative staff should be clear about the risks with tourniquet use, reduce opportunities for harm to occur and work collaboratively with other team members to reduce the risk of potential injury caused using tourniquets.

Introduction
Tourniquets are commonly used during limb and hand surgery by orthopedic and plastic surgeons and by anesthetists to enable regional anesthesia in a limb. They are a useful tool to assist the treatment process but have been shown to be hazardous to patients, without careful use. The perioperative team can significantly contribute to reduction in potential harm by awareness and implementation of risk reduction policies as well as displaying competency in their use. Local policy should guide safe practice.

Recommendation
Safe tourniquet practice
Before application of the tourniquet, perioperative staff should ensure that the correct site and side for application of the cuff, has been chosen and marked prior to the patient leaving the ward or holding area. Selection of the correct cuff size and site is also an important aspect of reduction to post-operative complications [(1)]. The manufacturer's instructions for safe use and application should be followed, in collaboration with the surgeon and anesthetist.
The tourniquet should be connected to the appropriate power and air/gas source and connected to the cuff prior to exsanguination of the limb. One of the safe practice objectives should be to reduce the time that the limb is subject to tourniquet pressure and ischemia; so, the cuff should not be inflated until all the team is ready to start the procedure.

A 'shut off' drape which covers and protects the tourniquet cuff may be used at this stage to reduce opportunities for fluid to cause burns or friction.

The perioperative nurse/practitioner should perform a skin assessment on the patient and document in the care plan. Application of the correct cuff is important as studies have shown that contoured cuffs fit most patients better than straight cuffs. In addition, cuffs should be wider than half the limb diameter so that arterial occlusion can be achieved at a lower pressure than a cuff with a narrow pressure bladder (2). Specific patient groups who may be at higher risk of ill-fitting cuff injury are the elderly, the young (pediatric patients), the obese and unusually small adults. In addition, use of a

tourniquet on a limb with infection or trauma is contra-indicated as are patients with sickle cell syndrome and those with peripheral vascular disease.

The limb should be wrapped with a soft, low, or non-linting material or stockinette underneath the cuff. The objective is to reduce wrinkling or pinching of the skin underneath the tourniquet cuff. Care should be taken not to site the tourniquet over any bony prominences as this increases the likelihood of nerve damage. [3] Cuffs may be sterile or unsterile, single use or reusable. Each will come with instructions for use and cleaning between uses, if applicable. Single use items should not be re-used.

Furthermore, it is important when applying a tourniquet cuff that the selected cuff fits with an appropriate overlap. Selection of a cuff that is too long may result in the cuff not fitting well and moving subsequently. A cuff that is too short may have uneven pressure which may prevent efficient occlusion [4]. Optimal overlap should be at least 7.5cms and not more than 15cms. [5]

Exsanguination can be achieved simply by elevation of the limb for 4-5 minutes (6) A Rhys Davies exsanguinate can also be used. Other methods of exsanguination are via the use of the Esmarch bandage which is wrapped by overlapping in a distal to proximal direction which forces the blood to be excluded from the limb before inflation of the tourniquet cuff. The Esmarch bandage should be used with caution and only if there is no other method available, as there is no possibility of controlling the bandage pressure. [7]

Limb occlusion pressure

Surgeons tend to practice a fixed inflation pressure (typically 250mmHg for an arm and 300 mmHg for a thigh) although studies advocate minimal pressure to achieve limb occlusion pressure (LOP). More recently it has been recommended that settings should be based on LOP used in conjunction with a wide cuff and that even with a safety margin added to the LOP that pressures can be reduced.

- LOP less than 130mm Hg, add 40mm Hg
- LOP 131-190mm Hg add 60mm Hg
- LOP greater than 190 add 80mm Hg

The recommendations for pediatric patients are to add 50mm Hg.[8]

LOP can be found by manually detecting the pulses distal to the potential cuff site using palpation or a Doppler ultrasound. The tourniquet pressure can be slowly raised from zero and the level of LOP identified, when the pulse is no longer detectable. Some of the most modern tourniquets have an automatic means to measure LOP. Each pneumatic tourniquet system will have its' own set up and staff and surgeons should be familiar with its use and safety systems.(9) Staff should be trained in the use of each specific tourniquet and complete a competency on tourniquet application and safety.

Inflation times

There is no absolute agreement regarding optimum times for tourniquet inflation and safe time limits of 1-3 hours have been described. [10] Prolonged inflation times, it is agreed, lead to serious patient injury, including extremity paralysis.[11] Recommended inflation times are that they should not exceed 60 minutes for an upper limb and 90 minutes for a lower extremity. For pediatric patients, inflation times of less than 75 minutes for lower extremities have been recommended. When prolonged inflation time is desired, the tourniquet should be released for reperfusion of the limb every 90 minutes, which should be enabled for 10- 15 minutes after which the tourniquet may be re-inflated for a further full period. If a further reperfusion is necessary, it is recommended that this is for 15-20 minutes. [12]

Complications

Most complications are related to nerve damage or excessive tourniquet time. [13] Some of the injuries are transient but some of the more serious injuries may be permanent, with a considerable degree of disability for the patient.

Nerve injury is the most common of the iatrogenic injuries. Symptoms of nerve injury include an inability to detect pain, heat, cold, or pressure over the skin along the source of the nerve and a sluggishness or inability to move large or small muscles on command. There may also be a permanent or temporary nerve paralysis in all motor nerves distal to the cuff.

Shearing injuries due to poor fitting cuffs have been noted in patients with flaccid or loose skin or equally on obese patients with large amounts of subcutaneous skin. [14]

Post- tourniquet syndrome has been described as due to the sudden release at the end of occlusion of metabolic toxins produced in the limb during ischemia. The signs of this syndrome are prolonged post-operative swelling of the limb, as well as weakness, edema, stiffness, abnormal sensations and pain.

Intraoperative bleeding may occur due to an under-pressurized cuff, insufficient exsanguination, improper cuff selection, loosely applied cuff, calcified blood vessels or too slow inflation or deflation. Compartment syndrome, pressure sores, chemical burns from pooling of skin preparation fluid, and DVT leading to pulmonary or venous embolization, tourniquet pain and thermal damage to tissues are other complications.

Massive pulmonary embolism has also been reported during inflation- so close patient monitoring is appropriate at this time. [15]

Monitoring and maintenance

Patient care

Assessment and monitoring of the patient's skin condition prior to and at removal of the cuff should be undertaken and documented. The patient should be carefully monitored during use of the tourniquet with consideration given specifically to hypertension and tachycardia. Immediately after deflation of the cuff, circulation in the limb needs to be checked.

Handover to post anesthesia care unit staff should include a report on pressure settings, duration of the pneumatic tourniquet inflation, and patient outcomes when transferring the care of the patient into Recovery or to the ward, to ensure continuity of care.[16] Tourniquet pain is one of the most common side effects of tourniquet use, and may develop during and following tourniquet use. Hypertension and a dull aching pain have been described. [17]

Post-operative evaluation should include vital signs, including oxygen saturation; temperature; skin condition under the tourniquet site e.g. temperature, color, and skin integrity; pulses distal to the site of the tourniquet cuff; surgical wound site and blood loss. [18]

Equipment care

Prior to use, each tourniquet should be checked to ensure that it is not malfunctioning. Staff should inspect and test the entire tourniquet system before each use and according to manufacturer's instructions. This may include but is not limited to: calibration of the system (units may be self-calibrating on startup); integrity and functionality; inspecting the cuff, any O-rings and tubing for cracks, tears and leaks; inspecting adapter connections, if used, for security; checking to ensure alarms are functioning; and ensuring if a gas source is used it is compatible with the equipment and design.[19] Check also that the Velcro fastenings on the cuffs are clean and functional. [20] Monitoring during use to ensure that the tubing is not kinked or twisted will assist in the reduction of possible nerve injuries.

Throughout surgery it should be possible to visualize the display panel on the tourniquet to monitor it for changes in cuff pressure (leaks) [21]

Inspection of the reusable pneumatic tourniquet system after cleaning, is essential after each use to prevent cross contamination. The inspection should include but not be limited to assessing for: thorough cleanliness; any obvious discoloration remaining due to blood or residue; any physical damage to the cuff, for example, any rips, tears, holes, unevenness or rippling along the length of the cuff when laid flat; intactness of the positive-locking hose connector(s) on the valve stem; cracks or damage on the black "O-ring" on each connector; tears, frays or broken stitching on the colored ribbon or on the self-closure strap; and more than 25% of the strap contact closure material being embedded with fibers that cannot be removed[22].

Documentation

Many of the modern tourniquet units have automatic time displays. In the absence of this, perioperative personnel should record inflation times and subsequent deflation on the swab board where it may be seen by all the team. The surgeon should be alerted verbally after one hour of inflation and at 30-minute intervals thereafter [23]. A record should also be made in the patient's perioperative record of

- Cuff location and size
- Type of skin protection used such as padding device, soft orthopedic wool or stocky
- Cuff pressure
- Times of inflation and deflation
- Skin integrity under the cuff before and after use of the tourniquet
- Identification of the person who applied the cuff and the person who checked the skin integrity after removal of the cuff. [24]

Biers Block Anesthesia

Intravenous regional anesthesia or Biers block is a form of regional anesthesia heavily dependent on using a pneumatic tourniquet. The anesthesia is used for short duration surgery on an extremity. [25] All the safety features of the tourniquet are required as above and checks prior to and after use are required.

A double tourniquet is used to increase safety and to reduce tourniquet pain in the awake patient, but there is potential for confusion and accidental deflation of the wrong cuff, which may lead to toxic systemic levels of anesthesia [26]. Safety features of the tourniquet described by McEwen include that the tourniquet should have two completely independent channels so that each may be reliably controlled, especially at the end of Biers Block when they each need to be depressurized and re-pressurized to release small quantities of local anesthesia back into the circulation over time. The variable contour of the cuff is recommended to ensure a close fit ensuring reliable even pressure distribution across each bladder. Each cuff also required separate closure devices to increase patient safety. LOP should be able to be measured automatically and in some tourniquet instruments there is an automatic lockout mechanism which prevents both cuffs being deflated at the same time. [27]

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EORNA Best practice of protection and prevention of surgical smoke

Statement

Surgical smoke contains gaseous by-products which could be hazardous to members of the surgical team, including the patient. During surgery when using devices that produces smoke/plume the team-members may inhale the by-products or the ultrafine particles, UFP, may fall on the skin or gets into one's eyes. In laparoscopic procedures the ultrafine particles in the smoke may be absorbed into the patients' blood stream through the peritoneum and cause hypoxic stress. Protection and prevention from ultrafine particles are of importance for patients and health care personnel involved in surgery.

Key words

Prevention, protection, surgery, smoke, plume, heat-producing device, rapid mechanical tool, laser, diathermy, ultrasound device.

Purpose/objectives

The purpose of the recommendation is to offer a knowledge base for operating room nurses and health care personnel working in the perioperative environment to be aware of the risks of surgical smoke/plume of gaseous by-products used during surgical interventions. Another purpose is to know about the prevention and protection from hazardous ultrafine particles. Including: description of the problem, assessment of risks, special observations.

Introduction

During almost all surgical procedures heat-producing equipment is used on the patients' tissue. These devices are used for dissection or hemostasis. This medical technical equipment is necessary and performs important functions for example, preventing bleeding by coagulating small blood vessels, to allow more visibility in the surgical field and they fill an important role by shortening procedure-time. The benefits of these devices offer more efficient surgical techniques and they allow surgery within various surgical risk-areas.

When using rapid mechanical devices and heat-producing devices, smoke plume, is generated. Surgical smoke, which is mix of combustion gases, is formed during heat-producing energy and is generated example when using monopolar and bipolar diathermy, laser surgery, dissection with argon gas, ultrasound, high speed burrs, saws, drills, cutters and mechanical morcellators etc.[1, 2, 3] Surgical smoke is described in the literature as a gaseous by-product resulting from energy-based instruments and devices used in tissue. These gaseous by-products are ultrafine particles, UFP, and contains bio aerosols with both viable and non-viable cellular material. Diathermy smoke contains chemical and biological substances that are considered as mutagenic, carcinogenic, and possibly infectious. The smoke contains dead and living cell material from the patient's tissue, HPV DNA, toxic gases, mutagenic and carcinogenic materials.[2, 3, 4, 5, 6, 7]

The most common chemical substances occurring in surgical smoke are described in the literature as hydrocarbons, fatty acids, phenols, nitriles, acrylonitrile, hydrogen cyanide, benzene, and toluene. [8, 9, 10] Chemicals identified in laser smoke are benzene, formaldehyde, carbon monoxide and hydrogen cyanide. HIV-DNA and bovine papilloma virus DNA has been detected in the laser aerosols. [11]

By-products of ultrasonic devices are usually described as aerosols or steam. These aerosols arising on low temperature is more likely to contain viable and infection carrying particles compared to particles generated at higher temperatures. [6, 12] Large quantities of cellular material are found in surgical smoke produced by ultrasonic dissection.[13]

Saws, drills, etc. are included into these, which become hot during use. These devices are cooled down with flushing of cold sterile fluid to reduce the temperature of the tissue, and this in turn creates a steam of aerosols that may contain blood and fluid products. [2]

Particle size
Living cells have a size of about 15 microns. [14] (Bjålie et al., 1998). The smoke generated using heat-producing medical devices includes ultrafine particles, UFP, of less than 0.1 microns. [10]
Electrosurgical particles are 0, 07 micrometers and is considering dangerous because of the chemical composition. Laser particles are 0, 31 micrometers and particles from ultrasonic dissection are 0,35 – 6,5 micrometers. Viruses and bacteria may be of a minor size. [15]

Effects of surgical smoke
Chemical components may be absorbed through the skin and lungs. They have a toxic effect that can cause irritation of the eyes, nausea and vomiting, headache, sneezing, weakness, and dizziness. Even emphysema, asthma and chronic bronchitis can be caused by surgical smoke. Benzene is documented as a "trigger" for leukemia. [2, 12] Carbon monoxide is problematic for the patient during laparoscopic surgery, because the risk of absorbing carbon monoxide through the peritoneum into the blood stream. Increased amounts of carboxyhemoglobin, HbCO, and methemoglobin, MetHb, cause hypoxic stress in healthy individuals through reduced oxygen-carrying capacity. 3 Benzene and toluene has been found postoperatively in patients' urine after laparoscopic cholecystectomy. [16]

Distance of smoke, spread of smoke
In the environment, due to the spread of smoke, the smoke from various medical devices spreads the smoke in different ways. De Brooder et al. [15] who studied the smoke from electrosurgery, and carbon dioxide laser could see that the smoke from the carbon dioxide laser was spread more explosive and further away from the surgical field compared to the smoke from electrosurgical devices. High concentrations of ultrafine particles, UFP, occurs over short exposure periods during abdominal surgery according to Bruske-Hohfeld et al.[17] and the first seconds, when using diathermy or laser, generates high levels of UFP and thus contains many hazardous substances. [18] Curved or straight blades of the instruments have significance for the spread of the smoke, [19] and the material of the blade has additional importance for reducing the surgical smoke. [20]

Prevention and protection
Ventilation in the operating room
Conventional ventilation, at least 15 air exchanges/hour, where air is filtered, or it may be ventilation where laminar airflow is used. (See EORNA recommendations of Ventilation)

Evacuation systems
A central evacuation system is powerful, quieter as it is installed outside the operating room.
Mobile evacuation system - The effective systems is the triple filter system with an ULPA (ultra-low particulate air) -filter or HEPA (high efficiency particulate air) -filter, which captures particles of 0.1 microns and larger, the capacity is nearly 100%. The systems have a pre-filter which catches the largest particles. The ULPA filter is the second stage of the filtration. The final filter is an activated charcoal filter that absorbs toxic chemical ingredients and the odors from smoke.[21]
It is important to place the diathermy-pen with its suction within 2 cm from the source of smoke production. Factors affecting the capability of capturing the smoke; the capacity of aspiration flow (liters/min), the distance between the suction and the source of smoke production, the inner diameter of the suction hose and the amount of smoke produced during the operation. [21]
When bipolar diathermy is in use it is preferable to have a wand for smoke evacuation, which is connected to the smoke evacuation system with HEPA or ULPA-filter, and the same recommendation may be used for ultrasonic dissection devices, or a wand may be connected to the instrument in use.

Laparoscopic smoke evacuation system with ULPA-filters: special filters are available and should be on a trocar during the whole operation to prevent leakage of smoke in the open air in the operating room.
Smoke evacuation systems should always be used during the procedure with heat-producing instruments or devices.

Personal protective equipment
To reduce exposure from surgical smoke, personal protective equipment is used.
It is important to protect the respiratory system, the eyes, and the skin. [22] The eyes need protection by glasses and for the skin gowns and gloves are appropriate safeguards. Face masks used today (IIR), filter particles 5 microns or larger, according to Ulmer 2 and Benson et al. [22] Respirators can filter particles that are 0.1 microns.[2, 22] Respirators FFP3 masks are classified according to European Standard EN 149: 2001 + A1: 2009. The most effective are masks with HEPA filters. When using masks, they must be used correctly according to the manufacturer's instructions. [23] The face mask or the alternative respirator is "the last line of defense" against inhalation of ultrafine particles, UFP, and as health care personnel it is important to assess what is relevant to use.

Filter replacement
Changing mobile evacuation systems filters should be considered as hazardous. The filters should be considered as infectious materials, [4] because of the waste from surgical smoke. It may remain a risk to inhale ultrafine particles (UFP) or get these UFP on the skin or in the eyes, therefore the filters should be sealed effectively to prevent particles from entering the room air. Important to remember when changing the filters, is to protect the respiratory system, to wear eye protection and gloves, as well as protection of the working suit against contamination.

Education and training
Education and information about protection and prevention should be kept and available, specifically requiring training use masks properly.[22] In Europe, the employer must inform the workers about proper donning of protective FFP masks [3.24]

EU Directive
Legislation in Europe aims to minimize the health risks of biological agents at the workplace [25] European Parliament and Council Directive 2000/54 / EC on the protection of workers from risks related to exposure to biological agents at work) and carcinogens or mutagens at work [26] Directive 2004/37/EC. These regulations are minimum requirements which must be transposed into national law. In the directive of biological agents are divided into four risk groups depending on whether they can cause diseases and the possibilities of prevention and treatment. In the index list of the Directive, it is listed potential allergenic or toxic effects of biological agents. When it comes to activities that could pose a risk of exposure to biological agents, the nature, degree and duration of workers' exposure must be determined in order to make it possible to assess the risks for the workers' health or safety and to determine the measures to be taken. In the Directive includes measures described for mitigation.[27, 28]

The Directive requires the employer to:
- Assess the risks posed by biological agents
- Reduce the risk to the workers by:
- elimination or substitution
- exposure prevention and control

- information and training of the workers, and
- Provide health surveillance as appropriate

The European Commission has recently produced a fourth list of indicative occupational exposure limit values.[29]
Developments occur quite rapidly, and, in the future, there may be other methods of preventions and protections.

Recommendations

- Ventilation in the OR should be 15 air changes/hour with a positive pressure
- When using medical technical devices that generate ultrafine particles, it is recommended that effective evacuation systems and proper, correct use of the device during the whole time that the device is used and at the disposal of the product.
- Personal protective equipment should be applied correctly in order to reduce the risk exposure to ultrafine particles when using this medical technical equipment.
- Education of hazardous situations and prevention and protection should be mandatory and held by the employer for the health care personnel when new employees or when new equipment are introduced to the workplace.

Quality- and safety control preoperatively:
When preparing the surgical intervention, the instrument nurse/operating room nurse/scrub nurse/registered nurse should inspect the medical technical equipment that generates ultrafine particles to see if they are correctly prepared with an evacuation system. The personal protective equipment such as surgical face masks, respirator and eye protection should donned before the start of the procedure. When at risk of exposure of ultrafine particles, smoke evacuation systems are not sufficient, and a respirator must respirator be used. Control of smoke evacuation should be tested.

Quality- and safety control intraoperatively:
Continuous controls are made of the evacuation system during the surgical intervention.

Quality- and safety control postoperatively:
After the surgical intervention, the equipment should be disposed of carefully so as not to harm any health care personnel or patient. The ultrafine particles may still be left in the system. The filter is changed in accordance with the recommendation for the specific medical device so that they may continue to function optimally and do not pose health risks.

Observations

- If a regular suction has been used for smoke evacuation it is important to change the filter after the procedure and that the contents in the container can be evacuated in a safe and secure way, single use suction is recommended.
- If reusable suction has been used, one must be aware of the health risk when the contents are to be emptied in the disinfector. Use appropriate personal protective equipment.
- In cases where surgery is performed only with surgical gloves, and not surgical gown, it is important to remember when the medical technical devices are used, they may produce ultra-fine particles to be absorbed through the skin.

- Other health care personnel, for example students or personnel outside the perioperative environment, should be aware that the dissemination of ultrafine particles also can reach personnel who are further away from the surgical site.

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EORNA best practice for ventilation in Operating Room

Statement

EORNA recognizes the importance of proper Ventilation and Air Conditioning in the Operating Room. Proper ventilation is essential to the health and safety of operating room surgical teams and patients. In the operating room environment, air quality is critical and is found to be related to the rate of surgical site infection.

Key words

ventilation, ventilation system, operating room, infection control, air quality, laminar air flow, surgical site infection, operating theatre

Purpose/Objective

The purpose of this statement is to concentrate EORNA's recommendations related to ventilation and air conditioning in the operation room, based on the latest research and best practice of the most developed countries in the world.

Introduction

High quality air in the operating room is a one of the most important factors in controlling the risk of surgical infections. Bacteria settling on surgical instruments or entering directly into the surgical site by dust particles, textile fibers, skin flakes, and respiratory droplets may result in surgical site infections (SSI). Minimization of airborne bacteria and other sources of contamination leads to reducing the morbidity and healthcare costs associated with these infections. Controlled airflow systems - HVAC (heating, ventilation, air-conditioning systems) have the most important role in controlling this kind of contamination. [1] Room ventilation affects the distribution of these airborne particles in four ways: total ventilation (dilution), air distribution (directional airflow), room pressurization (infiltration barrier), and filtration (contaminant removal).[2]

Ventilation

Airflow can be inward, from the outside into the OR (negative pressure), or outward, from the OR to the outside (positive pressure). Negative pressure ventilation is uncommon and used only for high infection risk rooms in the hospital (e.g., isolation rooms for tuberculosis patients). Positive pressure ventilation is used for protective environments (e.g., ORs and rooms with immunocompromised patients). [2, 7, 8] Doors to the operating or invasive procedure room should be kept closed except during the entry and exit of patients and personnel. Several studies have demonstrated the negative effects of OR door openings. [9]

The "Guidelines for environmental infection control in health-care facilities" issued by the CDC and AORN's Guidelines for providing a Safe Environment of Care recommend a minimum of about 15 exchanges of filtered air per hour, 3 (20%) of which must be fresh air. The 2008 edition of ANSI/ASHRAE/ASHE Standard 170 ("Ventilation of Health-care Facilities"), recommends a minimum of 20 total air exchanges per hour and a minimum of 4 exchanges of outdoor air per hour in operating theatres.[1, 8, 9]

Common ventilation systems in OR:

Conventional

Conventional (mixing) ventilation systems are used in ORs in old hospitals, the majority of which are in developing countries. These systems are normally used for general surgeries, for example, Abdominal Surgery. These systems cover only one zone in the OR and present a turbulent airflow dynamic. The use of this system is not a good option for the OR, mainly in Class I surgeries, because of turbulence it is impossible to guarantee that the air is clean around the patient and on the instrument table. This type of ventilation system can be installed on the ceiling and sometimes also on the walls.[4]

Plenum

Plenum ventilation systems are used in some countries, including the Netherlands where they are the most common system in use in ORs. These ventilation systems can be used for different types of surgery. There are different types of Plenum ventilation. This kind of ventilation divides the OR in to thermal and protection zones. [4]

Laminar air flow

This type of ventilation system is used all over the world, and is recommended for environments, which require ultra-clean air, including ORs Class. To have Class I characteristics, these ventilation systems are combined with the use of the high-efficiency particulate air filters (HEPA), and a low and uniform velocity. There are two types of LAF system, horizontal and vertical. Vertical LAF is more effective in the OR than horizontal, because clean air is supplied directly over the operating table, and more effective according to some studies. LAF may divide the OR into one or two zones, according to the design of the diffuser. [4]

Laminar airflow through HEPA filters demonstrates a 99.97% efficiency in removing airborne particles of 0.3 µm and above and is supplied to the operating area by ceiling-mounted (vertical flow). It is recommended for all kinds of operations.[1, 5, 7, 8]

However, according to Global guidelines on the prevention of surgical site infection (WHO, November 2016), laminar airflow ventilation systems may not be necessary to reduce the risk of SSI for patients undergoing total arthroplasty surgery.
There is evidence that suggests that laminar airflow ventilation has no benefit when compared to conventional ventilation in reducing the SSI rate in both total hip (THA) and knee (TKA) arthroplasty. In THA, conventional ventilation had a non-significant beneficial effect in reducing the risk of SSI. Therefore, the GDG unanimously agreed that laminar airflow ventilation systems need not be used as a preventive measure to reduce the risk of SSI for total arthroplasty surgery. The strength of this recommendation was conditional, considering the lack of supporting evidence.[10]

Combined system

This system is a mix of different systems. Combined systems are not common and are not proven to be a good way to control surgical site infection. [4]

Temperature and humidity
Many studies have shown that keeping patients warm during the perioperative period is highly beneficial. Additionally, the comfort of the surgical team should be kept in mind. Recommended temperatures for ORs are between 20 to 23°C (68 to 73°F) during surgery and recommendations for the post-anesthesia care unit (PACU) are between 21-24°C (70 to 75°F)[2, 3, 5, 8]

Humidity control is important because decreased humidity may lead to damage in the respiratory tract and loss of body heat through evaporation of sweat. Excessive humidity is also undesirable for patient and staff comfort, and not suitable for keeping equipment in sterile condition. Relative humidity should be approximately 30%-60% in most ORs and in the PACU.[2, 3, 5]

Recommendation

- Positive-pressure ventilation between the OR and the corridors should be a gold standard. For this reason, the ventilation systems and airflow should be left on 24-hours a day, 7 days a week, and 365 days a year. It helps to keep positive pressure inside the room and to not let dust and microorganisms enter inside.
- Doors to the operating or invasive procedure rooms should be kept closed except during the entry and exit of patients and personnel.
- Negative pressure ventilation is uncommon and used for high infection risk rooms in the hospital (e.g., isolation rooms for tuberculosis patients).
- Minimum of 15 total air exchanges per hour and a minimum of 3 exchanges of outdoor air per hour.
- Laminar airflow through HEPA filters and supplied to the operating area by ceiling-mounted (vertical flow).

  ***Remark**: WHO does not recommend the use of Laminar airflow as a preventive measure to reduce the risk of SSI for total arthroplasty surgery.

- Air conditioner systems should be able to cool and to heat the clean airflow and be able to keep temperature stability + - 1^0 C.
- Recommended temperatures for ORs are between 20 to 23°C (68 to 73°F) during surgery and recommendations for the post-anesthesia care unit (PACU) are between 21-24°C (70 to 75°F). Relative humidity should be approximately 30%-60% in most ORs and in the PACU.

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EORNA best practice for electrosurgical safety in operating room

Statement

Electrosurgical equipment in the perioperative environment includes a range of devices which convert energy from high frequency electric current into heat to incise and coagulate tissue at the point of application. These devices have the potential to cause electro-thermal injury, interfere with implantable devices, cause fire, explosion, and damage to equipment, and produce potentially harmful smoke plume.

The safe use of electrosurgical equipment will have a positive influence on the patient's surgical outcome and protect perioperative personnel. It is essential to have a basic knowledge and understanding of electricity and the risks associated with electrosurgical equipment.[1]

Key words

Electrosurgical equipment, patient safety, monopolar, bipolar, burns

Introduction

The term electrosurgery can be used synonymously with diathermy. Electrosurgical units are high risk medical devices which have been the cause of numerous patient safety incidents and operating room fires. They should be used with caution, knowledge, and skill. The electrosurgical generator is the source of electricity flow and voltage. The circuit comprises the generator, the patient and the patient's dispersive plate as well as the active electrode (which is the instrument on the sterile field). Most generators are now isolated, which has made them electrically much safer than in the past. Many of the modern generators also have internal quality monitoring constantly reviewing the contact between the patient plate and the generator, to reduce the chance of patient burns. However, electricity will always find the quickest route to earth and this may be via operating table positioning pieces, staff members and equipment. Vigilance when positioning patients is required. Manufacturer's instructions for use shall be provided and a brief set of clearly readable operating instructions should be readily accessible with each machine. [2] Policies and procedures should be in place to minimize the risks to patients and staff and which facilitate continuing risk reduction.

Monopolar electrosurgery

Monopolar electrosurgery is the passage of a high frequency current through the patient from the active electrode to the return electrode (or dispersive plate or indifferent electrode). The flow of the current is resisted in the tissue, producing heat. If heat is produced in a small area such as the tip of electrosurgical forceps, this heat will cause electrosurgical effects.

These effects are cutting, coagulating and fulguration. The effect can be achieved by using a contact technique, where the electrode comes into firm contact with the tissue or a non-contact technique where the electrode is near the tissue.

- Cutting is the use of non-contact high power, low voltage to disrupt cells, causing a split in the tissues. It is used to cut through muscles, skin, or fat.
- Coagulation is caused by the relatively low power, low voltage current heating cells to produce a soft coagulum. This waveform is often used during contact coagulation of blood vessels.

- Fulguration is the use of non-contact high power , high voltage current to spray sparks over a wide area leading to superficial destruction of tissues. This waveform is sometimes used during electrosurgery to the cervix. (3)

Bipolar electrosurgery

Bipolar is an electrosurgical technique in which the effect takes place between paired electrodes placed across the tissue to be treated. No patient return electrode is needed. Typically, bipolar forceps are utilized for this technique.

The distance between the active and return electrodes in a bipolar circuit is small since both electrodes are adjacent to each other. The distance the current flows is limited and is contained in the vicinity of the two electrodes. As current passes through the tissue from one electrode to the other, the tissue is desiccated, and the resistance increases. As resistance increases current flow decreases. (4)

Bipolar is frequently used when:-

- Coagulation only is required (coagulation is required in peripheral areas of the body such as hands or feet or other areas where 'channeling' of electrosurgical current may occur leading to potential for accidental burns along the return current pathway)
- Pinpoint or micro-coagulation is required.
- The patient has a pacemaker in situ
- Using a laparoscopic approach. (5)

Recommendation

Body piercings if possible, should be removed before surgery, as there is a risk of burns from them from electrosurgical equipment (13) – although this has also been disputed in the literature. (14).

Electrosurgical Generator

Electrosurgical safety can be enhanced by adhering to principles of safe management. Instructions for use and regular maintenance by experts should ensure that the electrosurgical generators remain safer in use.

The unit when in use, should not be leaned on, have fluids close to it or be covered in paperwork. The LED power levels should always be visible and electric cables which are unimpeded and under no stress or stretch. Prior to every use on a patient or a surgical list, the electrosurgical generator should be checked to ensure it is working and that the alarms are also functioning and audible. The unit will sound an alarm if the patient plate (dispersive electrode) is not connected to the machine. The footswitch should be covered with a clear impervious cover if there is potential for fluid spills (6)

The unit should be set at the lowest effective power setting for coagulation and cutting. Increased power settings beyond recommended levels should be questioned and documented. If the operator

requests a continual increase in power settings, a team member should check all the connections and accessories in the circuit for correct attachment. (7)

Indifferent electrode/ dispersive pad/ patient pad

The patient's skin integrity should be checked and documented, prior to placing the pad. The patient's skin should be rechecked, and condition documented at the end of the operation. The appropriate size pad should be used for adult, pediatric patient or neonate and should be carefully placed. The pads should never be cut or folded. They should be placed when the patient is positioned for surgery and prior to draping. If the patient must be repositioned during surgery, the pad and cable should be re-checked for contact and adherence [8] Place the patient pad in as proximity as possible to the surgical site.

The pad should always be placed in a well vascularized tissue area such as the outer thigh or buttock area. Adipose tissue and bone have high resistance and conduct electricity poorly whereas muscle and skin are conducive to electricity. The area should be dry and free from hair. The pad should not be placed over bony prominences, scar tissue or over any implants. [9] Placing the dispersive electrode over a tattoo, many of which contain metallic dyes, should be avoided. Although there have been no reported electrosurgery injuries from dispersive electrodes placed over tattoos, superheating of the tissue has occurred during magnetic resonance imaging. There is a theoretical possibility of this also happening with electrosurgery. [10]

Active electrode

The active electrode (instrument) should be checked visually prior to use by the scrub nurse/ practitioner to ensure there are no obvious impairments. Each unit should be electrically checked to ensure that if there are any insulation breaks, that they are identified during reprocessing in sterile services and not at the operating table. Insulation failures allow an alternative pathway for electric current to leave the electrode and may result in the surgeon getting an electric shock or a burn. When not in use, the active electrode should be placed in a clean, dry insulated protective holder to reduce the opportunity for inadvertent activation causing the patient harm. [11]

The tip of the active electrode should be kept clean and free from eschar, as it causes the instrument to become less efficient. This may be undertaken with an abrasive pad, designed for the purpose. Some electrode tips which are available are coated they should be cleaned with a damp swab rather than an abrasive pad.

Surgical smoke plume

Smoke from diathermy and lasers has been shown to contain low concentrations of toxic gases and vapors' such as benzene, hydrogen cyanide, formaldehyde, bioaerosols, dead and live cellular material (including blood fragments and viruses); these produce an unquantified infection risk. The smoke causes ocular and upper respiratory tract irritation, is highly obnoxious, and creates visual problems for the surgeon. There is evidence of mutagenic potential. Currently there is no evidence of human carcinogenicity, but there are persistent concerns. There are no current EU standards to guide safe practice.

Theatres usually have high rates of general ventilation. This does not, however, prevent the emission of smoke into the room or the exposure of staff. Local exhaust ventilation (LEV) is required to achieve this. The known irritancy, the other hazardous properties of the component contaminants, and the persistent concerns of chronic effects combine to lead to the conclusion that effective LEV should be considered a required control measure.

LEV for surgical smoke control is still being developed. Two current approaches are purpose designed portable smoke evacuators and room suction systems. Smoke evacuator systems can be add-on units

or supplied as part of the diathermy or laser equipment package. For fine work and where space is limited, extraction systems designed as part of the device are usually less cumbersome. None are without some impediment to the ease of use by the surgeon.

The irritancy of surgical smoke may affect some staff (especially asthmatics) adversely despite effective LEV. Anyone reporting respiratory symptoms should be referred to the occupational health service. (12)

Burns and other hazards

Electrosurgery is potentially hazardous both to the operator and to the patient. Few clinicians understand the technology and it is often not used with as much care as it should be.

Flames and sparks caused by using an electrical current during surgery can be the cause of perioperative fires in an oxygen rich environment - head and neck surgery is especially high risk. A further hazard which has been the reported cause of many fires isa where skin preparation fluid is often alcohol based. The alcohol has not been allowed to dry or evaporate during skin preparation and the fluid has pooled beneath the drapes. Fumes have subsequently caught alight and either exploded or burned the drapes and the patient.

In advertent activation of the electrosurgical unit is identified as a frequent cause of skin burns to either patients or staff. This is often caused by the active electrode not being placed in the safety holster whilst not in use.

Burns can also occur when too much electric current flows through too small an area for too long a time. This may be the case where the patient's skin is touching a piece of metal equipment and unintended burns may be the result. Depending on the density of the current and the exposure time, the burns may be second- or third-degree burns.

Electromagnetic interference

Patients with pacemakers and other implanted cardioverter defibrillators (ICDs) and ventricular assist devices can be affected by the electromagnetic interference caused by monopolar electrosurgery. If electro-cautery is to be used, pacemakers should be placed in a triggered or asynchronous mode; ICDs should have arrhythmia detection suspended before surgery. Bipolar diathermy only should be used, and the devices checked after surgery to ensure they are functioning again correctly. (13)

Reports of patient safety issues with deep brain stimulators have also been reported and need extreme caution when electrosurgery is used. The device needs to be turned off prior to surgery and bipolar only used. (14)

Minimal access surgery hazards

Personnel should be instructed in the risks of electrosurgery during minimally invasive surgical procedures.

Capacitive coupling

A capacitor is created wherever a non-conductor separates two conductors, which creates an electrostatic field where one conductor can induce a current in another. This may transfer the electrical current from the active electrode through intact insulation to adjacent conductive items (e.g. tissue, trocars), which may create hidden harm in nearby tissues. (15)

Direct coupling

Direct coupling is the result of touching the laparoscopic active electrode to another anatomic structure. This can cause necrosis of underlying tissue. Insulation failure of the laparoscopic electrode can be caused by trauma during use or reprocessing. Current leaves the electrode through this alternate pathway. This can cause serious patient injury, particularly when the injury is internal. [16]

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EORNA recommendation practice for Laser safety

Statement

Optical radiation devices, which include lasers (Light Amplification by Stimulated Emission of Radiation), light emitting diodes (LEDs) and intense pulsed light (IPLs) devices are technologies of which the benefits are well documented. There are however many hazards associated with their use and the procedures which govern their safe perioperative use must be strictly adhered to prevent accidents and harm to their recipients and their users.

Key words

Laser classification, risk management, working environment , safety

Purpose/objectives

Laser hazards

There are several hazards associated with laser use in the clinical environment. Accidental exposure to the laser light which might be caused by a misdirected or misaligned beam; light escaping from the protective housing of the unit or a broken or detached optical fiber. In addition, further hazards are to be found in reflections of the light from shiny surfaces of surgical instruments, or corneal contact lenses and binocular indirect ophthalmoscope viewing lenses.

Risk assessments

The principle of risk assessment is well established in the face of high-risk devices and the environment in which they are used, given the potential harm which may occur if laser hazards are not reduced. In assessing the main hazards with lasers, consideration should be given to the following, the optical and skin hazards of the laser radiation beam itself as well as the general equipment hazards which are

- Fire- high power, direct and reflected beams and flammable material on the sterile field i.e. sponges and drapes.
- Mechanical – manual handling risks with large machinery and gas cylinder drops. Slips trips and falls.
- Electrical – high voltages

Introduction

The use of lasers requires stringent rules and standards which all personnel adhere to reduce the risks. Standards which are set by the International Electrotechnical Commission are the basis for safety standards accepted around the world. EU Directive 2006/25/EC combines recognition of those expert based standards together with occupational safety regulations, and individual Member States have their own local laws and standards.

Lasers are a source of light energy which is amplified to a high intensity by a process of stimulation. There are many different types of laser which may be based on gases, semiconductors or are solid state lasers. Many medical specialties use lasers for a wide variety of applications, very successfully.

Laser classification

Lasers are classified by assigning them to one of four broad classes- depending on the potential for causing harm. (1). Most surgical lasers are in designation 3B or 4.

Designated Detail of hazard class
Class 1. Safe if not disassembled (laser printers/ CD Rom players/ drives)

Class 2. May exceed class 1 exposure limits if viewed for more than 0.25 seconds (aversion response time), but still does not pose a significant eye hazard (e.g. supermarket scanners)

Class 3a. Eye hazard if viewed using collecting optics (telescopes, microscopes or binoculars)

Class 3b. Eye hazard if means are viewed directly or specular reflections are viewed.

Class 4. Eye hazard if beams are viewed directly or specular reflections- and sometimes even diffuse reflections – are viewed. Also, skin burns from direct beam exposure. Fire hazard as beam may ignite flammable materials.

The working environment
Mechanisms for controlling the risks are advised in national legislation but essentially are around reducing the opportunity for inadvertent harm from laser emissions. The environment in which the device may be used – which may be an operating theatre or procedure room, access should be restricted to those who need to be present, to placing nonflammable barriers/ blinds on the windows, and signs outside the doors announcing use of the laser with appropriate warnings.
Interlock mechanisms may be recommended to protect personnel from accidental exposure to hazardous lasers. They can monitor several doors, windows or blinds fitted with safety interlock switches and disable the laser if any are opened.

Recommendation
Availability of personal protective equipment, specific to the laser in use must be available to all staff and patients who may enter this environment.
Eyes
Exposures highlighted above may well damage different parts of the eye anatomy, the type of damage depends on the wavelength of the laser. The light from some lasers will be absorbed by the cornea and lens whereas for others it will penetrate to the retina. If the optic nerve is damaged, then partial or total loss of vision may occur. For a patient, the damage could be particularly severe if they are anaesthetized and unable to react. [(2)]
Staff protection
When lasers are in use, protective eyewear must be worn. Protective eyewear is specific to the laser class and type – and to be effective it must therefore be of the correct optical density and wavelength to protect the wearer. Eyewear should be labelled with the appropriate optical density. [(3)] They should be available at any time the laser is in use and shall be regularly inspected for scratches or damage. The eyewear should have side shields and should be stored in individual cases between uses. [(4)]
Patient protection
If the patient is awake for the procedure, the same eyewear, as used by the staff should be worn by the patient.
However, if the patient is under general an aesthesia specifically designed eye protection, should be available and used. This may be using a water-based lubricant on the conjunctiva, gently closing the patients' eye lids, and securing them closed with tape or alternatively providing laser eye shields which are laser specific. The latter are available as single use or reusable products.

Skin

Skin is susceptible to damage from optical radiation i.e. tissue burn due to the intense heat produced particularly by class 3b and 4 lasers, used in medical practice. Large areas of skin may be protected by light absorbing or light scattering materials (e.g. regular clothing). Hazards to hands and face may require shielding. [5] Skin burns are a not uncommon side effect of aesthetic clinic treatments.
Exposed tissues around the surgical site should be protected with saline soaked materials, (e.g. towels, sponges) when lasers with a thermal effect are being used. The saline absorbs or disperses the energy of the laser beam in areas not intended for laser application. [6] Saline sponges should be regularly re-wetted to reduce opportunities for fire in the gauze.

Chemical

Surgical smoke has been explored elsewhere see diathermy / electrosurgical safety.
Lasers can emit considerable volume of surgical smoke into the atmosphere of the operating room – which should be mechanically removed as close to the surgical site as possible.
Analysis of the airborne contaminants produced during laser surgery has shown that laser plume contains toxic gas and vapors (e.g. benzene, hydrogen cyanide, formaldehyde); bio-aerosols; dead and living cell material, including blood fragments; and viruses. [7]

Fire

Fire safety measures should be in place whenever a laser is used, and staff should ensure they have regular education on fire safety. Fire safety principles should be applied within the laser working area, to reduce the opportunities for the laser beam to cause dry materials in an oxygen rich environment to explode or catch fire. Patients can be caused harm very quickly.
Specific perioperative hazards include are but are not limited to: -

- Flammable liquids or ointments
- Oil based lubricants
- Alcohol based skin preparations
- Plastic or foam-based positioning devices
- Electrical failures
- Gases
- Paper or gauze materials
- Flammable surgical drapes
- Reflective instruments
- PVC or other non-laser specific endotracheal tubes
- Flexible fiber-optic endoscopic sheaths / biopsy channels [8]

Staff should ensure that safety devices (fire extinguishers) are on hand to fight fire – should it occur. It might also be advisable for sterile saline or water to be available in the event of a fire in or close to a patient.

Electrical

Laser devices are high powered electrical devices and should be managed appropriately. All electrical safety hazards should be recognized by staff and reduced within the environment as far as possible. Care should be taken when plugging and unplugging equipment. Slips trips and falls can occur in a darkened environment where there may be many electrical cables on the floor. Insulation of the device cables should be regularly checked for integrity and secured between uses, in a safe manner.

Liquids should not be placed on the machines to avoid the risk of spills and thereby electrical shocks or failures. Staff should receive regular education from manufacturers or other experts to maintain their safety knowledge and awareness of the hazard reduction.

Regular maintenance of the laser should be arranged.

Patient safety

Patient safety is best maintained by adherence to strict discipline in the working area, protection of the patient's high-risk skin and eyes during the procedure and continuing education of all staff involved in using the laser to reduce patient risk.

EU and national standards will be set and local rules for the safe use of lasers should also be in place.

Staff safety

Local rules will probably identify a hierarchy of experts who have been appointed to take a lead role in ensuring the safety for patients and staff for all lasers. Some healthcare systems employ a hospital-wide role of laser protection advisor and several laser safety officers depending on the number of areas where lasers are used within the facility. Local rules will have been devised by these experts to ensure risk reduction for staff and patients, as far as possible.

It is usual that key controls are in use for lasers. This system ensures that inadvertent or inappropriate use is rare. A list of authorized and trained users is commonly held and should be kept up to date. When not in use the key should be securely locked away and a logbook held of uses and key releases. The laser foot switch should be placed in a position convenient to the operator, thereby reducing the chance that the beam will be unintentionally activated, causing harm to patients or staff.

Incident reporting

There will be local or national rules for incident reporting – which may be within the hospital or more widely. Staff should be aware of the local recommendations and ensure that they practice them.

Education for users

All users within the laser hierarchy should be educated for safe practice, reduction of risks and management of best practice for patients. This should be attended on a regular basis and records held.

Management and Maintenance

Policies and procedures for safe management of the equipment, the environment and people should be developed and kept up to date, in line with national and EU guidance and in line with international standards.

The units should be fitted and commissioned by the specific manufacturer and device specific education given prior to first use.

Regular ongoing maintenance should be purchased by the healthcare institution for the purpose of reducing risk.

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European Operating Room Nurses Association

EORNA best practice for Specimen Management

Statement
EORNA recognize the importance of specimen management in the continuity of patient treatment. Careful management of specimens is essential to safe practice.

Key words
Specimen, responsibility , tissue , frozen section, formalin

Purpose/objectives
Access to accurate specimen analysis reports is essential for the delivery of safe, effective, and appropriate treatment. That accuracy is dependent on all staff i.e. clinicians, nurses and laboratory staff handling specimens in a safe, careful, and systematic way. The removal of a patient's tissue to confirm diagnosis may be the only reason for the patients' surgery. It may determine the pathway of treatment for the patient and therefore should be handled with care, respect, and accuracy.
Accordingly, all specimens must be treated as 'precious' and handled i.e. saved, identified, and transported with extreme care and attention to detail. Delays in transporting of specimens to the appropriate testing laboratory, may compromise the outcome for the patient

Introduction
A specimen is defined as any bodily substance or tissue taken from a patient for the purpose of analysis i.e. blood, urine, and tissue. Specimens are routinely taken to assist with healthcare diagnosis and treatment.
All specimens are potentially infectious. Accordingly, all specimens must be treated as potentially hazardous. The number of staff handling specimens should be kept to a minimum. Standard precautions must be practiced when handling any body tissue.
Careful management of specimens is essential to safe practice. A key responsibility of all perioperative team members is to handle, contain, label, dispatch and transport the specimen(s) to the correct laboratory together with appropriate documentation. The validity of the test results may depend on good practice by the perioperative team procuring the sample for testing.

Recommendation
Specimen collection
Specimen handling should be assessed and planned by the surgical team prior to commencement of the procedure to include

- Specific equipment required
- Prior notification given to any department whose support is required for transport, etc.
- The surgical team is responsible for booking special tests with the laboratory i.e. lymphoma , TB testing, prior to the procedure and to inform the surgical team of this at TIME OUT
- Cultural considerations i.e. (retention of limbs for burial)

Specimen Identification and Preparation
The operating surgeon is required to audibly identify the name of each specimen to the scrub nurse/practitioner once it is removed.

The scrub nurse/practitioner must verify the following information and relay it to the circulating nurse/ practitioner:

- The type of specimen e.g. tissue; lung, thyroid
- The exact site of the specimen including laterality
- The type of fixative required i.e. formalin
- The location and names of marking sutures if present
- Once verification is complete and understood, the specimen should be handed off the surgical field as soon as possible.
- Once the specimen is handed over, the circulating nurse/ practitioner is responsible for:
- Safeguarding the specimen i.e. preventing misidentification, damage or disposal Securing the specimen in an appropriately sized, impervious specimen container
- Ensuring the specimen is stored in the correct fixative solution or fresh as dictated by the surgeon

Errors

Makary et al (1) identified that errors occur in 3.7 per 1000 specimens from operating rooms and involve the absence of accurate labelling, omission of details regarding tissue site and the absence of patient name. Incorrectly labelled specimens could result in incorrect diagnosis, with possible critical implications for the patient. The loss of a specimen could prevent a definitive diagnosis and the subsequent initiation of the correct or any treatment may be delayed.

Avoid errors

- The patient should be clearly identified with at least two identifiers (e.g. name, date of birth, hospital number, address).
- The circulating nurse/ practitioner should confirm the specimen details with the scrub nurse/ practitioner or the surgeon directly, by reading aloud the name of the patient listed and the title of the specimen, including the site of origin and any markings or orientations for the pathologist.
- If there are multiple specimens to be taken, the local policy should dictate whether this requires a requisition form for each specimen or one with clear annotation and numbered specimen jars.
- Technology has allowed for individual bar - coding of specimens, with labels once they are entered on the patient's electronic record. This enables the laboratory to ascertain the number of specimens from a particular patient and assists with ensuring that specimens are not lost in the transfer process. Any system is only as good as the process in place to ensure that it is failsafe. It should be clear, exactly what analysis and reporting of the specimens taken, the surgeon requires. Depending on the pathological investigation required, the specimen will need to be managed differently.

Preparation of the specimen

is determined by specimen type; for example, most histopathology specimens are fixed by a preservative such as formalin. The integrity of the specimen must always be upheld and should be fixed before it dries out. Containment is necessary, as formalin is a toxic substance which staff should not be exposed to more than necessary. Staff should be wearing suitable personal protective equipment (PPE) when handling formalin. [6]

Frozen sections are sent dry and their process should be expected by the laboratory and pre-planned. Most laboratories have a 30-minute rule for dry specimens, the specimen starts to denature after 30 minutes has passed, and this can alter the histological image of the disease. Therefore, it is vital that fresh specimens are dispatched immediately to the histology laboratory for processing.

Frozen section specimens
A frozen section is defined as when a piece of tissue is removed for analysis for immediate identification of possible malignancy. Specimens are quick-frozen, sliced, stained, and examined in a laboratory under a microscope. This tissue is sent to the laboratory in a specimen container which contains no fixative or other solution. The histology form should have been prefilled by the surgeon prior to scrubbing in for surgery. The patient's details are filled in on the form or electronic record and the telephone number of the operating theatre must be included to ensure the laboratory can contact the surgeon with the results.

Fresh specimens
Specimens may be sent to the laboratory "fresh" without fixative if arrangements are in place to ensure that the specimen will be processed on arrival to the laboratory. Fresh specimens must be processed in a 30-minute timeframe to ensure that the tumor cells do not denature.
Some specimens, especially those with a potential diagnosis of TB or lymphoma, will need to be fresh and dry. Others for bacteriology/ microbiology will need to be covered by a transport medium. Microbiology specimens must be sent to the laboratory urgently for culture to ensure that patients do not develop sepsis while awaiting culture of tissue taken in a surgical procedure.
All specimens should be clearly marked as being radioactive using appropriate hazard labels. Radioactive specimens can be transported as normal by the partnering staff.

Containing the specimen
Operating room staff must select the correct and appropriately sized container for the specimen being sent to the laboratory. It is recommended that prefilled formalin containers should be provided for staff in a range of different sizes, to prevent the need for fume cupboards and decanting of formalin in large volumes. This is to ensure that staff are not unnecessarily exposed to formalin fumes. Empty specimen containers in the same range of sizes must also be provided for specimens that are sent to laboratories for a range of testing including tissue biobanking and research in university teaching hospitals. At times, specimens may be unusually large and may require special arrangements to be safely secured for transport to the laboratory.

The specimen should be able to float freely in the preservative, so as the tissue absorbs it, there is sufficient to fix the tissue effectively (5). If the outside of the container becomes contaminated, it should be cleaned prior to dispatch to protect the staff transporting the specimens. Labels on the specimen container, should not be applied to the lid, but the body of the container, so that the patient data and the tissue do not become separated. [(6)]

Labelling the specimen
The perioperative nurse/ practitioner should confirm with patient's medical record the following information on the specimen container and specimen form(s) using a black indelible ink. Patient labels must have the correct patient details recorded

- Patient's full name,
- Patients Medical Record Number, Patients Date of Birth
- Name of Ward
- Name of Consultant Surgeon Name of specimen
- Date and Time
- Specimen details should be listed during the Sign out process, to ensure that all specimens are correct and accounted for.

Specimen transport

If immediate transport to the laboratory is not possible, microbiology specimens should be stored in a fridge at 4°C and dispatched as soon as possible. Fixed specimens for histopathology may be held at ambient temperature – should they be refrigerated, the fixation process by formalin will be delayed so this is not recommended. (8)

Specimens should be transported carefully, to maintain their integrity.

It is good practice for a logbook to be held by the Operating Suite to note all dispatched specimens, their exact nature, patient demographic details, specimen titles and name of person transporting them to the laboratory. The laboratory should also have a receiving logbook, so that there is continuous record of the chain of custody for specimens. (9)

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EORNA best practice for Natural Rubber Latex Allergy

Statement
Natural Rubber Latex (NRL) is a substance with the potential to cause ill health in some individuals who develop allergies to it, which can result in symptoms ranging from irritant skin rash to severe respiratory distress (anaphylactic shock). In health care settings there has been an increase in the use of NRL gloves as a barrier against the transmission of blood borne viruses and bodily fluids; however the reaction demonstrated by some healthcare workers may be a response to the NRL from which the glove is made or to other chemicals used in the manufacturing process. It should be noted that there are many medical devices which contain NRL, but many have been substituted in recent years by the industry.

Key words
Latex, allergy, symptoms, irritation

Purpose/objectives
Operating Theatres should be alert to the need to identify patients and healthcare workers for whom this is an issue and take risk assessment and preventative action to reduce the risk as far as possible and without delay.

Introduction
Natural rubber is used in a variety of healthcare products, including many used in an operating room. Glove use has risen exponentially since the mid-1980s when HIV and the rise of difficult to treat Hepatitis B and C viruses became a risk to healthcare workers.

Sensitization to NRL may occur at any time and may become more likely when exposure is repeated on a regular basis. Frequency of exposure is associated with more severe reactions. Accordingly, safety from a latex sensitivity is a shared responsibility of employers and employees. Each employer has a responsibility to provide a safe working environment by providing a wide range of latex free products for use as required. Each employee has a responsibility to be informed about hazards within the work environment that have the potential to create a risk for themselves and the patient.
There are three recognized types of reactions:-

Irritation
This is a non-allergic condition, the effects of which are usually reversible. The irritation may occur when the skin meets hazardous substances or is immersed in water for long periods of time. Natural rubber latex gloves are being used and a rash may occur on the back of the hands which is characteristically dry and itchy. These symptoms usually resolve once contact with the hazardous substance i.e. natural rubber latex product is discontinued. It is important to note however that skin irritation may be caused by a wide range of substances. For example, skin cleansing and disinfecting agents may induce skin reactions which may be confused with NRL sensitization. Where necessary, advice should be sought on a differential diagnosis, precautions, or treatment from an occupational health physician.

Delayed Hypersensitivity (Type IV)
This reaction is predominantly caused by an allergy, for example to the residues of accelerating agents used in the manufacturing process of gloves. Also known as allergic contact dermatitis, the severity of

this type of allergy varies greatly. It is often characterized by a red rash on the back of the hands and between the fingers. The skin may become leathery and express papules or blisters. The reaction is delayed, occurring several hours after contact, reaching a maximum after 24-48 hours and then subsides. Repeated exposure to the allergenic substance may cause the skin condition to extend beyond the area of contact with the gloves or other medical device. In some cases of natural rubber latex sensitization this may result in the individual becoming sensitized to unrelated NRL containing devices.

Immediate Hypersensitivity (Type I)
This reaction is an immune response to, for example natural rubber latex proteins. This type of reaction, sometimes referred to as an Immunoglobulin E (IgE) response, generally produces symptoms within 5 –30 minutes of exposure. Such a reaction is almost immediate in effect but usually diminishes rapidly once contact with the material has ceased. The symptoms are characterized by local or generalized urticaria and edema. If mucous membranes are affected, rhinitis, conjunctivitis or asthma may result. Respiratory difficulties and anaphylaxis may occur in extreme cases. Anaphylactic shock, characterized by generalized hives, respiratory distress and low blood pressure can occur within minutes of exposure. It is most likely to occur when the skin barrier is broken or the NRL device comes into contact with mucous membranes. The potential allergens which produce Type I reactions exist in the finished product as protein or process residues. These are water-soluble and readily leach out of the natural rubber latex. The washing process used in glove manufacture often removes substantial amounts of proteins and process residues. Some will remain, to a greater or lesser extent, depending on the frequency of washes and the chemical processes used. Indeed, some gloves are now available on the market with nearly all of the proteins removed and may be suitable for Type I allergic persons. Repetitive skin or mucous membrane contact with any latex product containing high protein residues may cause sensitization. Once this has occurred future allergic reactions may be caused through contact with NRL products containing lower residue levels.

Recommendation
Managing and reducing risk
The essential core of managing a natural rubber latex allergy reaction is to assess the environment and the person.

Risk assessment is the key factor in improving the working environment in the health care sector and this key role is emphasized in the EU Framework Directive of 1989 stressing the obligation of the employer to assess the risks and implement protective measures. The EU legislation on safety and health at work (http//osha.europa.eu/legislation/directives) places special emphasis on prevention as opposed to treatment, thus enhancing the role of risk assessment for the management of health and safety. Within the frame of this requirement it has been shown that a collaborative or participatory approach when health care workers and management work together to identify problems and implement evidence based solutions has been the best way to deal with the working environment issues in the sector. [(2)]
There are several routes of exposure including [(3)]

- direct external contact (e.g. gloves, natural rubber latex face masks, blood pressure cuff tubing).
- airborne sources that can affect the mucous membranes of the eyes, nose, trachea, bronchi and bronchioles, and oropharynx.
- particles that are swallowed after entering the nasopharynx or oropharynx.

- direct contact of the mucous membranes with indwelling natural rubber latex devices such as catheters.
- internal patient exposure from health care provider use of natural rubber latex gloves during surgical procedures; and internally placed natural rubber latex devices, such as wound drains

Staff may be put at an unnecessary risk by the following:

- The use of powdered rather than non-powered natural rubber latex gloves that carry an even greater sensitization risk to both user and the patient.
- The inappropriate use of examination gloves for procedures or tasks, which require different levels of protection.
- The use of natural rubber latex gloves (or other types) as a substitute for proper hand washing procedures. Residual chemicals and latex proteins on hands post glove use.

Glove powder is not in itself allergenic but has a powerful affinity for NRL proteins leaching them from the glove to become airborne when the glove is removed. These airborne particles can then be inhaled representing a risk for those with Type 1 Immediate hypersensitivity.

The Personal Protective Equipment (PPE) Regulations require that, if following a risk assessment, avoidance of, or reduction in, the exposure to a hazardous substance or activity is not possible by other means, personal protective equipment appropriate to the activity being undertaken should be provided. The type of glove to be worn will be determined by a risk assessment of the activity during which exposure to a substance requiring that glove to be worn is identified

Hospital policy framework

It is recommended that hospitals create a multidisciplinary group to ensure that all services account for any latex within the care environment to patients with a sensitization. Staff in many departments will also need to receive training so that they understand that their actions have or may have an impact on the patient for example the kitchens and housekeeping services.

Policies need to be developed to manage the latex sensitive patient in all areas of the hospital with attention to high risk areas. Accident and Emergency, Operating Rooms, X-Ray departments, Intensive Care Units and Dental services are all high-risk areas.
Policies also need to be developed for the management of latex sensitive workers. [4]

Patient assessment

It is essential that as part of the pre-assessment process for surgery, that patients are identified to have raised risk factors for latex sensitivity. Latex sensitization typically occurs in people who have had frequent surgical procedures, those who have spina bifida and in healthcare workers. There is some, yet poorly understood crossover with food allergies.

As soon as a patient's status has been determined as having a sensitivity to NRL (at whatever level), It should be clearly marked on the patient's notes, in all communication documents and with other members of the multidisciplinary surgical team.

Reducing risk during surgery

The following steps should be followed during care of a patient with a latex sensitivity who requires surgery or another invasive procedure in a non–latex-safe environment:

- remove all latex-containing products from the room the evening before the procedure, except those that are sealed or contained.

- do not use latex products during terminal cleaning of the room the evening before the procedure.
- schedule an elective surgery as the first procedure of the day.
- restrict traffic and equipment in the operating room before and during the procedure; and
- when no latex-safe alternative is available, cover latex-containing equipment that comes into direct contact with the patient with stockinette.

Removing latex-containing products from the room the evening before the procedure and using non-latex products during terminal cleaning is thought to help reduce the release of latex particles. Scheduling elective procedures as the first of the day provides time for room air to be completely exchanged after terminal cleaning. Covering latex-containing equipment with stockinette provides a barrier between the equipment and the skin.

Signs indicating "latex allergy" should be posted on all doors leading into the theatre where the procedure will be performed before the start of the procedure.
Postoperatively, the patient should be transferred to a latex-safe care area. (5)

Many operating suites are now latex free to reduce risks, some have identified a specific operating room as a latex free room and others, as suggested above are cleared for the occasion, when a patient is known to be sensitive.

Procurement assistance

Purchasing or procurement staff can assist theatre personnel to find and establish a data base of latex free alternatives, for equipment and medical devices used within the operating room, anesthetic room, and recovery.

Many companies now provide a vast range of products and medical devices which are latex free. The database is worth reviewing annually to ensure that it is up to date.

A systematic review of the literature showed that using low-protein, powder-free, natural rubber latex gloves or latex-free gloves significantly reduces natural rubber latex aeroallergens in the environment, as well as sensitivity and asthma in health care workers.(6)

Quality-of-life scores improved in health care workers with latex allergies after latex products were removed from the workplace. Participants were asked to complete a questionnaire that addressed quality-of-life scores related to skin, eye, and respiratory symptoms that they experienced because of exposure to latex in the workplace.(7)

Hand Hygiene and 'wet work'

Healthcare staff have an incidence of diagnosable work-related contact dermatitis which is many times higher than the average for other workers. Frequent exposure to soaps and cleaners, and 'wet work' (work involving wet hands or hand washing), account for over a quarter of all cases of work-related contact dermatitis (8).

- The term 'wet work' is used to describe work that involves the hands being wet for significant periods during the working day; as a guide more than two hours a day or washing hands frequently, twenty to forty times a day.
- A long time spent washing or frequent hand washing, particularly in combination with soaps and detergents can strip the skin of its natural protection and lead to dermatitis.

- Additionally, irritant contact dermatitis can be caused by 'wet work' scenarios created through wearing gloves.
- The elasticity, firmness and correct functioning of the skin depends on its moisture content and retention of water is aided by substances in the skin called natural moisturizing factors (NMF).
- If the moisture content is too high or too low, it can affect the skin's barrier properties.
- Wearing gloves can prevent sweat from evaporating and cause NMF production to stop, leading to irritant dermatitis and other skin ill health effects such as the invasion of micro-organisms which jeopardize the intention of skin hygiene. By using the hand medic moisturizer provided in clinical areas, this effect can be eliminated / reduced.

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European Operating Room Nurses Association

EORNA best practice for Chemical safety in operating room

Statement

In perioperative working environments, staff and patients may be exposed to a variety of potentially hazardous chemicals. It is the role of the employer and each employee to ensure that the risk is assessed, that exposure is reduced as far as is possible, that appropriate personal protective equipment is available for self-protection and that waste procedures for disposal are managed according to best practice and local policy. EU Directives cover most rules for safe use and should be adhered to, to promote the safest working environment for all healthcare workers.

Key words

Chemicals, dangerous, risk, regulation, products

Purpose/objectives

Fortunately, a large amount of guidance is available for employers and workers in dealing with dangerous substances. And across Europe, there are many examples of good practice to learn from. By taking appropriate action, workers can be kept safe while using dangerous substances. Employers are also obliged to provide workers with information on the risks posed by hazardous substances, and training in how to use them safely. Regulations apply both to marketed products and to the waste and by-products resulting from production processes.

If the risks of using dangerous substances are not effectively managed, workers' health can be harmed in a variety of ways, with effects ranging from mild eye and skin irritations to asthma, reproductive problems and birth defects, and cancer. This can be through a single short exposure, or multiple exposures and long-term accumulation of substances in the body. [1]

Introduction

By law, employers in the EU must protect their workers from being harmed by dangerous substances in the workplace. Employers must carry out risk assessments, and act on them. Legislation also governs the identification and labelling of the thousands of different substances that are registered in the EU market. Reducing the risks of working with dangerous substances is not just a moral and legal imperative – there is a strong business case for it as well. Organizations can suffer when things go wrong, through lost productivity, and increased liability to prosecution and claims for compensation - as well as workers.

recommendation

The essential components of best practice are, when working with substances which may be harmful, ensure the following:-

- assess the risks to health from chemicals and decide what controls are needed.
- use those controls and make sure workers use them.
- make sure the controls are working properly.
- inform workers about the risks to their health.
- train workers

Assess the risks

Principles of assessment should be to identify whether harm can be caused by chemicals via the following:-

- Exposure by breathing in

- Once breathed in, some substances can attack the nose, throat, or lungs while others get into the body through the lungs and harm other parts of the body, e.g. the liver.
- Exposure by skin contact

Some substances damage skin, while others pass through it and damage other parts of the body. Skin gets contaminated:

- by direct contact with the substance, e.g. if you touch it or dip your hands in it; o by splashing.
- by substances landing on the skin, e.g. airborne dust.
- by contact with contaminated surfaces – this includes contact with contamination inside protective gloves. (2)

Exposure by swallowing
People transfer chemicals from their hands to their mouths by eating, smoking etc. without hand washing first.

Exposure to the eyes and other mucous membranes
Some vapors, gases and dusts are irritating to eyes. Caustic fluid splashes can damage eyesight permanently. Blood and body tissue can transmit blood borne infections.
Exposure by skin puncture
Risks from skin puncture such as needle stick injuries are not uncommon in perioperative care and can involve the potential of blood borne disease.
Risk assessment is not a paper exercise; it should be a means of identifying and communicating the risks in the environment to every worker. Risk assessment enables staff and the hospital to put effective controls in place to reduce potential exposure to harm.

Control measures
Control measures may be provision of ventilation in the operating theatre to reduce gases or availability of personal protective equipment. Control measures may also involve new ways of working to reduce exposure e.g. closed mixing systems for methyl methacrylate or local exhaust ventilation systems for the filling of specimen pots with formalin.

Standard operating policies should be written, following risk assessment, and supervision of all staff to ensure they use the techniques and policies.

When choosing measures which may control exposure, identify methods using a priority system

- Eliminate the use of a harmful product or substance and use a safer one.
- Use a safer form of the product, e.g. paste rather than powder.
- Change the process to emit less of the substance.
- Enclose the process so that the product does not escape.
- Extract emissions of the substance near the source.
- Have as few workers in harm's way as possible.
- Provide personal protective equipment (PPE) such as gloves, coveralls, and a respirator. PPE must fit the wearer. (3

Most of the products in use in operating theatres will have manufacturer's safety data sheet (MSDS) available – use the information as a basis for the risk assessment, and ensure that the information is always up to date and available to staff. MSDS are readily available on the internet.

Equally, ensure that control measures are maintained and are used every time by all staff.
Personal Protective equipment is identified in these guidelines in the section on standard precautions.
New international symbols have recently been agreed across the world. Symbols will be in use from June 2015 and will replace the orange backed symbols currently in use in EU. (4)

New ways of working to reduce risk
Involve the perioperative staff in designing new ways of working to reduce exposure. They know the product and how it is used in the operating suite and may well supply the risk assessor with a practical solution to reduce risk.

Training of personnel
Identification of the dangers to which staff are exposed, the control measures which have been chosen or a new way of working to reduce exposure and the policy, should be taught to staff on induction and at frequent updates.

Monitoring the exposure of staff
Baseline occupational health checks will be undertaken when staff are newly employed and at subsequent intervals. Staff should be referred for individual assessment if they appear to be suffering a reaction or problem.

Monitoring the environment
Monitoring the environment can be undertaken by a variety of different methods depending on the chemical being measured. National workplace exposure limits are also in place for such chemicals as anesthetic gases.

Chemical spillage
Management of chemical and other product spills should be undertaken by trained individuals ideally using a spillage kit, designed for the purpose. All spillages should be cleared promptly to prevent exposure to a wide number of people. Local waste management regulations should also be adhered to regarding disposal of hazardous waste.

Local storage for chemicals
The storage of small quantities of hazardous chemicals is safest if they are segregated from other products and the cupboard is locked. The store area should be well ventilated, with a through draught. The spillage kit can be stored close by.
Separate:- solid and liquid products, flammable and nonflammable liquids, acids and alkalis and wastes.
Store products containing chemicals securely in a cool, dry, dark place. o Store containers so that their labels face forward.
Store heavier items and corrosive chemicals on lower shelves (5).

REACH
Reach stands for Registration, Evaluation, Authorization, and restriction of Chemicals and is EU regulation. It was adopted to improve the protection of human health and the environment from the risks that can be posed by chemicals.

REACH places the burden of proof on companies. To comply with the regulation, companies must identify and manage the risks linked to the substances they manufacture and market in the EU. They

have to demonstrate to the European Chemicals Agency (ECHA) how the substance may be safely used and they must communicate the risk management measures to the users. (6) Authorities can ban hazardous substances if their risks are unmanageable. A full inventory of classified substances is available on ECHAs website.

Under REACH, if hospitals are using hazardous chemicals, then there will be extended safety data sheets available which highlight exposure scenarios which contain practical advice on the conditions under which the chemicals can be safely used. (7)

Chemicals which need to be assessed for safe working practice

The list of products in use in many operating suites but is by no means an exhaustive list includes:-
Anesthetic agents – risks to be assessed for use in the anesthetic room using a variety of different anesthetic techniques and also in recovery room for exhaled risks from patients.
Formalin and other histology fixing agents.
Glutaraldehyde and peracetic acid for cold chemical sterilization Ethylene Oxide used for sterilization of products
Methyl methacrylate for bone cementing. Disinfectant and other cleaning solutions Alcohol based pharmaceutical products Cytotoxic drugs
Latex products

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EORNA
European Operating Room Nurses Association

EORNA best practice for Radiation safety in operating room

Statement

The medical use of ionizing radiation is beneficial to patients but has risks attached to it. Healthcare professionals involved with its' use in hospitals must ensure that appropriate protection measures are in place to protect patients and staff. Strict guidance on the use of, protective measures and the responsibilities of employers are set by EU Directives and local policy. Measures must be in place in operating rooms when ionizing radiation is used to ensure safety and that exposure is controlled to be as low as is reasonably practical.

Key words

Radiation, risk, safety, education, exposure, protection

Purpose/objectives

Patients and staff exposed to medical ionizing radiation on a regular basis are at risk from the effects of a cumulative dose over a period. Steps must be taken to reduce the impact of this increasing exposure; the general steps include time, distance and shielding. The ALARP/ ALARA principles to assist with radiation doses are TIME – minimizing the time of exposure directly reduces the radiation dose. DISTANCE – doubling the distance between the body and the radiation source will divide the radiation exposure by a factor of 4. SHIELDING – using an absorbent material such as Lead for X-ray and gamma rays is an effective way to reduce radiation exposures.

Introduction

Radiological procedures are an invaluable medical diagnostic and treatment tool and provided that proper safety measures are in place and are followed, create only minimal risks to both the patient and personnel. (1)

The Directive 2013/59/Euratom repeals previous Directives but does not have to be implemented by Member States until February 2018. Regulations on occupational health and safety relating to exposure to X-Ray and other dangers of ionizing radiation may change by implementation of the Directive. (2)

Exposure to radiation should only occur if it is to provide a benefit to the patient. The known risks from undertaking the procedure have to be balanced against the benefit to the patient of having an earlier or a confirmed diagnosis or a treatment. The Directive sets dose limits for occupational exposure, which are based on international recommended limits by the International Commission on Radiological Protection 2007. The principle of a dose that is 'as low as is reasonably practicable' (ALARP) 'or achievable' (ALARA) (3) is used to ensure the risk from exposure to ionizing radiation is controlled.

Recommendation

Risks and Dose Limits

X-rays of all frequencies can damage tissues and may produce long term effects. The effects of radiation are dose dependent and cumulative: the larger the dose or the more frequent the exposure, the greater the risks of the effect of radiation. (4) Evidence has demonstrated that ionizing radiation is absorbed by developing cells, which indicates that any developing fetus should be protected from X – ray. The greatest risk is the development of cancer. Healthcare workers who do not protect themselves from scatter radiation are especially at risk when performing interventional procedures, because of significantly increased exposure time and proximity during the procedure.

Exposure levels are measured in Sievert (Sv)or MilleSieverts (mSv)The age limit for occupational exposure is set to 18 years.

Dose limits for occupational exposure set by the Directive 2013/59/Euratom are as follows:

- for effective dose limit: 20 mSv in any single year.
- in special circumstances: up to 50 mSv in a single year (the average annual dose over any five consecutive years must not exceed 20 mSv).
- for the lens of eye: 20 mSv in a year or 100 mSv in any five consecutive years (the average annual dose over any five consecutive years hall does not exceed 50 mSv).
- for the skin and extremities: 500 mSv per year.
- or an unborn child: 1 mSv (preferably zero);
- for breastfeeding workers: no radionuclide intake or bodily contamination.

for apprentices and students aged between 16 and 18 years: 6 mSv per year
The Directive also specifies that the responsibility for radiation protection rests with the employer and that exposed workers shall be informed of radiation health risks and protection procedures, the relevant procedures, precautions and emergency response plans and procedures and the importance of complying with requirements. They shall be aware of the importance of making an early declaration of pregnancy. [5]

Pregnancy

The International Commission on Radiological Protection has set out some guidance for safe practice for exposure to medical radiation in pregnancy which is summarized by the international atomic energy agency (6). When relating to patients, each radiation exposure must be justified, meaning that the decision to have the exposure to provide diagnosis or treatment is more important to the patient than a possible pregnancy.
For staff where there is continuing possible exposure over the length of the pregnancy, the staff member should declare their pregnancy at an early stage so that responsibility for moving the worker to an alternative role can be made. For intermittent exposures, the pregnant worker should remove themselves from the situation or ensure that the protective measure they take, are as safe as possible.

General Protective measures

Individuals may be required to wear a dosimeter, which measures exposure over a specified time (usually a month or three months). They should be worn at waist or trunk level and beneath protective equipment. Dosimeter readings are reviewed usually by a Radiation Protection Supervisor (RPS) and should there be any concern, the working practice and environment of the member of staff can be investigated. [7] In Germany there is a national registration scheme which is used to record accumulated doses of exposure over a working life. Everyone can be tracked. Monitored staff with dosimeters , rarely reach an accumulative dose that exceeds or approaches their annual dose limit. In general, many local radiation protection authorities only recommend dosimetry for those who work constantly work in high dose areas.

Each Member State will have its' own regulations regarding monitoring and the principles of these are laid down by the International Commission on Radiological Protection and contained within the EU Directive on Basic Safety Standards.

Perioperative protection

During any use of X-ray, the constant monitoring of radiation safety precautions for patients and personnel shall be a shared responsibility between the surgeon or operator, the radiographer or

radiologist and the perioperative staff. Patient protective measures shall be used when X- Ray is used in an operating room.

Appropriate protective equipment should be available during any perioperative procedure involving radiation. Lead aprons reduce the exposure to sensitive tissues, which can absorb radiation. The major critical organs which should be protected are breasts, gonads, lungs and thyroid. Shields for patient protection should be applied before sterile drapes are applied. Lead aprons are said to reduce possible exposure by 75-90% and should be used to protect the staff as well as the patient.

The best protective aprons are wrap around or those which cover the wearer's back as well as their front. Additional shields which may be used are collars to be worn when near the patient (1 meter) to protect the thyroid gland. There are also led eyeglasses , they are more commonly used during interventional radiology procedures where exposure to X-ray may be for a longer time.

Other protective measures are awareness of where to stand when a C arm is being used for fluoroscopy – or standing as far away as possible. The scattered radiation from the patient comprises the main source of radiation dose to staff. Measurements have shown that scattered radiation from a patient's body is more intense at the entrance side of the X -Ray beam i.e. on the side where the X-Ray tube is situated. Therefore, it is better to stand on the side of the detector. Staff should stand on the side of the transmitted beam, where scatter radiation corresponding to 1%-5% of the incident beam intensity, whereas on the alternative side of the C arm 100% scatter radiation is encountered. [8]

Management of protective equipment

Protective garments for example lead aprons or gloves should be:-

- uniquely identified with a code, so that faulty equipment may be withdrawn from use
- safeguarded from damage and cleaned after use- it is the responsibility of the user to return the garment in a clean condition and store appropriately
- examined visually at frequent intervals to ensure they remain undamaged.

Storage facilities must be available which allow lead aprons to hang freely and singly on appropriate racking. Such garments should not be folded or left on the operating room floor. Lead aprons are susceptible to cracking which can reduce their effectiveness as a shielding barrier. It is recommended that each apron is tested at least annually to ensure that it remains effective and is not cracked. Records should be kept. [9]

Environment

The operating room should demonstrate that X-rays are in use by notices or electrical signs outside the room, which restricts exposure of unprotected staff from entering the room.
All equipment used which can emit X-Ray should be subject to regular maintenance.
The operator – usually a qualified member of the radiology department should always alert the team when active X-Ray is turned on.

Staff education

Staff education on the risks and safety protection measure should be undertaken by staff at induction and at frequent intervals thereafter.
Policies and procedures in use will be hospital based and operating room suites should derive their practice and policy in accordance with local and national safe practice.

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EORNA best practice on prevention of inadvertent retained surgical items

Statement
A surgical safety counting procedure, SSCP, is required to ensure patient safety and accountability of all items used in a surgical intervention (soft goods, instruments, sharps, and miscellaneous items). The objective is to prevent the unintended retention of surgical items in a surgical patient's body. The occurrence of RSI (inadvertent retained surgical items) is considered preventable.

Key Words
Perioperative nursing, surgical count, surgical count procedure, surgical count process, patient safety, retained surgical items, surgical instruments, surgical sponges

Purpose/objectives
The purpose of the recommendation is:

- to guide the operating room nurse to perform a proper quantitative and qualitative procedure of sterile surgical items (soft goods, instruments, sharps, and miscellaneous) relative to surgical intervention, so that the patient is safeguarded.
- to guide the operating room nurse to act and cooperate with the surgical team safely and properly, so that the occurrence of an inadvertently retained surgical item in the surgical wound is prevented.

Introduction
The surgical safety counting procedure is an essential procedure for patient safety and well-being (AORN,2016; Joint Commission, 2013; ORNAC 2011; WHO, 2009).

Factors that affect sterile surgical equipment being left unintentionally may be acute surgery, unexpected surgical procedure change, extensive bleeding, and instrument/scrub nurse replacement during ongoing surgery, multiple surgical teams involved, prolonged and complicated surgery, among others (Gawande 2011; Gawande, Zinner, Studdert & Brennan, 2003).

"Counting is a human process that's very prone to error, especially in a busy environment where multiple things are happening simultaneously" Gail Horvath, a patient safety analyst of the ECRI (Emergency Care Research Institute - https://www.ecri.org).

Responsibility for the surgical safety counting procedure
The surgeon is responsible for everything that happens to the patient during the operation.
The surgeon's full responsibility is that SSCP is carried out and that he/she receives a report from the nursing staff.

Scrub and circulating nurses are responsible for executing the process and reporting the results to the surgeon.

The problem
Inadvertent retained surgical items, RSI, are mostly detected immediately after a procedure, after fluoroscopy, or X-ray, during routine follow-up visits, or from patient complaints about pain or discomfort. The most common location for RSI is in the abdomen and pelvis after surgery (Gümüş et al., 2012).

Unintended retained surgical items associated with surgical procedures may cause serious complications for patients such as:

- Adhesion
- Encapsulation
- Infection
- Abscess
- Obstruction
- Fistula
- Perforation
- Pain
- Vascular complications such as Thrombosis, Embolization
- Arrhythmia
- Tamponade
- Perforation
- Death

Factors that cause items to be left unintentionally can be:

- Related to the surgical team and interdisciplinary communication:
  - Incorrect and/or interrupted count.
  - Change of surgical nurse at shift changeover.
  - More than one surgical team is involved.
  - Fatigue of the surgical team.
  - The time in which the surgery takes place (for example evening, night, weekends).
  - Failure to comply with existing policies and procedures.
  - Failure in communication with physicians.
  - Inadequate or incomplete education of staff.
- Related to the surgical procedure and the patient:
  - The duration of the surgical procedure.
  - The degree of emergency of the surgery.
  - Unexpected or unforeseen change in operating method/technique.
  - An unexpected change in the patient's health/vital functions.
  - High Body Mass Index (BMI).
  - The complexity of the surgical procedure.
- Related to the environment:
  - Distractions such as equipment management during surgery.
  - The absence of policies and procedures.
  - A deficient physical organization of the operating room.
  - The lack of dedicated space for the counting of surgical items.

Recommendations

EORNA recommendations are based on literature reviews and the WHO Checklist for Safe Surgery. Surgical Safety Counting Procedures, SSCP, are to be performed as followed:

- Before the surgical procedure starts.
- When a new item is added during the surgical procedure.
- Before closing a cavity within a cavity.
- Before wound closure begins.
- The final count should be performed after skin closure and before the patient leaves the operatingroom.
- When suspected discrepancy.
- When permanent relief of the instrument/scrub nurse or circulating nurse or both.

Special Observations

- Systems for the safe handling of sterile instruments, sponges, peanuts, and other materials should be available concerning surgical interventions.
- Unsterile instruments used in the operating room for purposes other than surgery should be clearly labeled to be distinguishable from surgical instruments.
- Waste and laundry must remain in the operating room until the final procedure is completed.
- If an instrument or an item or a part of an item is left in the surgical wound, the surgeon should inform the patient or the patient's representative. This should be documented in the patient's health records. (AORN, 2016).
- Instrument counts may be waived in extremely rare circumstances for surgical invasive procedures in which accurate instrument counts are not possible or practical. Intra-operative imaging will be performed before the patient is transferred from the operating room if instrument counts are waived unless this puts the patient's safety at risk.

Preconditions for the surgical safety counting procedure, SSCP

- At surgical procedures, the operating room nurses are responsible for prescribed safety controls of surgical items. "Soft goods" such as sponges, "peanuts" and other non-woven or cotton gauze materials must be marked with sequentially numbered sponges, barcoding, or radiofrequency identification (RFID), which can be traced (Murphy, 2019).
- A table of content, or a list of all instruments in a set, is required for all instruments. The instrument sets should be standardized following WHO Guidelines (2009), and instruments that are not habitually used should be removed from the set and the list of contents (the few instruments, the easier and faster it is to execute the surgical safety counting method, and it is efficient/effective for the sterilization process). If variations from current procedures occur during an operation, the surgeon is responsible for implementing safety controls, which should be documented by both the operating room nurse and the surgeon.
- A surgical safety counting procedure, SSCP, includes quantitative and qualitative safety control preoperatively, intra-operatively, and postoperatively. The quantity stands for the number of items physically present in a set that must follow the list of contents.
- The scrub nurse and the circulation nurse should both do the SSCP loudly. The rest of the team must remain silent and cooperative during this time. The operating room nurse should count and record the number of surgical items, as well as whether or not the contents of the instrument set match the instrument list. Everything should be double-checked for sterility and integrity. The SSCP must be completed without interruption, and time must be set for this procedure. During this treatment, distractions should be kept to a minimum. Once a count has been started it should be completed. If an interruption occurs, the count should be resumed at the end of the last recorded item (ORNAC 2005)
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Soft goods

- Surgical textiles used during a surgical procedure should always have a traceable system in each item. Soft goods should be packaged in a standardized system such as 1, 5, or 10/package to facilitate the SSCP and documentation.

Anesthesia professionals

- Surgical and anesthetic products, as well as waste, must be kept separately, based on the danger of discrepancies during the per- and postoperative safety surgical counting procedure.
- Anesthesia professionals are not allowed to use any sterile items from the instrument set, they shall have their marked instruments only for use by anesthesia professionals.
- Remove any items or equipment used for anesthesia procedures, such as clamps and needles before the perioperative preparation, such as, disinfection and surgical site draping.
- Anesthesia professionals can help in retrieving and opening sterile goods like sutures and surgical textiles. This step must be communicated to the circulating nurse in the operation room. Extra items opened without adequate documentation and information will result in a discrepancy at the end of the procedure.

Surgical textiles

- The scrub nurse and the circulation nurse should separate each sponge, count it, and check the traceable marking. The count is done in a loud manner. Cutting the sponges into smaller pieces is not allowed.
- Each textile should be lifted out from the package and counted.
- If a non-standardized number of surgical textiles is found in the packagee.g. 6 or 4 instead of 5 sponges, 9 or 11 sponges instead of 10) the package should be sealed in a bag, marked and isolated, and taken out from the operating room.
- Surgical textiles with traceable markers aimed at the surgical procedure should not be used outside the surgical field (e.g. by anesthetists).Notify the scrub nurse or the circulation nurse as soon as an item falls from the surgical sterile field. Dropped things must be maintained effectively to ensure that they are properly documented.

Instruments and needles:

- Individually traceable numerations are required for both solo instruments and sets. This, as well as a table of contents for all of the instruments included, must be present for a secure counting process. The same safety and counting procedures should be performed for additional sterile instruments that may be opened during a procedure. After opening, needles should be inspected and placed on a safe surface before and after use. This will make it easier to count the needles while also protecting the surgical team from injury. If the instruments in a set are incorrect, imprecise, or incomplete when compared to the initial instrument list, the entire instrument set should be removed from the operating room. Before starting the surgery, a new set of instruments should be brought in, and a new safety counting should be conducted. Defective instruments should be removed, and corresponding documentation must be done accordingly.
- In case of breakage or dysfunction of an instrument, the surgeon must be informed,and the item should not be used for the rest of the surgical procedure.
- If one or more additional instruments or supplies are used during the surgery, the two nurses should count them and mark them in the patient's medical record. Sponges are immediately placed in a safe zone (for example, a pocketed sponge bag if they stay in the sterile field or a drop container outside the sterile field) for a visual assessment after being used in the sterile field. Depending on the system, each sponge or textile is arranged in a systematic manner, such as from bottom to top or "five in a row."The textiles like sponges shall be placed in an organized manner and with their traceable markings visible.
- Needles and blades, for example, should be counted in the same way as instruments and textiles are. The inner sterile package of a needle should be saved on the sterile table in a systematic order to help count them when needed. To avoid self-injury, used sharp items should be stored in a specially constructed container.
- If an instrument or item is broken when it is returned from the surgeon, it should be announced immediately, and a search should begin right away. When an item goes missing, the scrub nurse should reorganize the sterile field to get a better picture and the circulating nurse should search the operating room. The surgeon should pause the surgery if the situation allows it and perform a systematical investigation of the surgical wound or order an intra-operative radiograph until the missing item is found.
- The surgeon is responsible for removing sponges, instruments, and other materials from inside the patient's body before closing the surgical wound, and SSCP should be performed thoroughly without pauses or distractions. If the SSCP is interrupted, it should be restarted.
- The surgeon has to be informed if the SSCP has been completed successfully in an audible manner.
- In the case of bilateral procedures (i.e. bilateral inguinal hernia repair), textiles, sharps, instruments, and every pre-counted item must be completed at each incision closure (ORNAC, 2011).
- It is crucial to choose the right time to perform the SSCP, as it should not be done during a vital stage of the surgical procedure. The time-out phase and important intra-operative steps such as dissection, implant opening, or during an emergency are all examples of critical times. (AORN, 2016)

Relief of professionals

During a surgical procedure, a detailed information transfer should take place if the surgical team, such as the scrub nurse and/or circulating nurse be replacedfor any reason, for example, a shift change or a time out. . This information should include useful patient medical information, as well as what has been completed up to this point in the operation and what is still to come.

The oral information transfer also includes a complete and detailed summary of the instruments used up to that point as well as any counted materials. Any change should be recorded in the documentation accordingly. (Randmaa, Mårtensson, Leo Swenne & Engström, 2014, WHO 2007).

Postoperative Surgical safety counting procedure (SSCP)
The scrub nurse and the circulating nurse must provide a clear status report of the latest SSCP to the surgeon during the SIGN OUT Phase, according to the WHO (2009). The number of instruments, sponges, and needles, for example, provided and utilized throughout the surgical process, should match the Status Report.

All items should remain in the operating room until the final count has been performed and is completed (WHO 2009).

Only the scrub nurse and/or the circulating nurse are permitted to remove any items or waste from the operating room. All items should be removed from the operating room, once the patient has left, to prevent any misinformation in counting control during the next surgical procedure. (Steelman & Cullen, 2011)

Wound dressing
Wound dressing should be withheld from the sterile field until the surgical wound is closed.

Sponges with imaging such asx–ray-detectable thread, bar code, and radiofrequency ID should not be used as a wound dressing.

If a packing or fabric bind is used i.e. after nose surgery or in the vagina after prolapse, this must be with material other than a surgical sponge with an imaging detective marker on. This should be documented in the patient's record as a wound dressing.

Therapeutic packing
For example, if under special circumstances (damage control surgery) textiles are used as a tamponade in a cavity within a patient, it must be documented exactly what (in number) and where the contents are located in the patient. In addition, a detailed justification of this procedure must be explained in the patient record. A clear handover according to SBAR must be performed to the next caregiver in the corresponding care unit.

When the patient is returned to the operating room for a subsequent procedure or to remove therapeutic packing, the surgical team should determine from the record, the number and type of radiopaque soft goods that should be removed. The type and number of the removed radiopaque soft goods must be documented in the patient's healthcare records. The surgeon should inform the patient or patient's representative of any surgical soft goods purposely left in the wound at the end of the procedure and the plan for removing these items. (AORN, 2016)

Documentation

The perioperative count sheet(s) is a legal document and part of the patient's health record, so it should be included in the patient's health record (Accreditation Canada, 2019, Chapter 9; Rothrock, 2019). All utilized equipment, such as instruments, needles, sponges, and other countable items, should be noted in the patient's health care record for traceability. The names and roles of those who performed the SSCP, surgical safety counting method should be documented, as well as whether the count was correct or incorrect. If a mismatch is discovered and a course of action is followed, this should also be mentioned in the record. (AORN, 2016; WHO, 2009) If the SSCP was not performed during a surgical procedure, the explanation must be documented in the patient's medical record. (WHO, 2009)

If defective, broken, or fragmented instruments or items are detected during the qualitative control, the item should be removed and documented according to local routines or regulations.

Afterwords

The surgical safety counting procedure (SSCP) is performed differently in countries around Europe depending on regulations, traditions, and routines. However, performing a counting control for any item is critical to ensuring items are not forgotten or left behind in the patient,, as well as the mitigating any negative consequences that may follow. Organizations should establish a standardized approach for the prevention of unintended retained surgical items procedures.

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European Operating Room Nurses Association

Part 3

Infection control in the operating room

EORNA best practice for Standard Precautions

Statement
Standard Precautions are designed to prevent cross transmission from recognized and unrecognized sources of infection. These sources of (potential) infection include blood and other body fluid secretions or excretions (excluding sweat, non –intact skin or mucous membranes) and any equipment or items in the care environment which are likely to become contaminated. [(1)] They are the basic level of infection control precautions which should be used, as a minimum, in the care of all patients and regardless of their diagnosis or presumed infectious status.

Key words
Hand hygiene , standard precautions, infection prevention

Purpose/objectives
Hand hygiene is a major component of standard precautions and one of the most effective methods to prevent transmission of pathogens associated with health care. In addition to hand hygiene, the use of personal protective equipment should be guided by risk assessment and the extent of contact anticipated with blood and body fluids, or pathogens. [(2)]

Risk assessment is a key element for the health care worker, the minimum level of protection should be available, and additional precautions need to be assessed in case of extra risk or extra precautions which may need to be taken.

Introduction
Hand Hygiene
All healthcare staff will adhere to the principles and recommended practices to reduce the potential of transfer of microorganisms via the hands of the worker, according to the local and national policies and in line with guidance from the World Health Organization. Hand Hygiene is one of the most effective ways to prevent disease transmission and control infections in the health care setting.[(3)]
Personal Protective equipment (PPE) Appropriate personal protective equipment should be worn by all staff such as gloves, fluid-resistant gowns, head and foot coverings, face shields, masks and eye protection when there is a potential for exposure to blood, body fluid substances, or other potentially infectious material(s). [(4)]
It is the responsibility of the employer, to ensure that there is sufficient PPE for all staff to be able to access the protective equipment, which they may wish to use, whenever they assess that there is a personal risk from which they need to be protected. In Europe there is a Directive 89/ 656/ EEC which sets out the minimum requirements for local harmonizing laws. The Directive lays down minimal requirements for personal protective equipment at work [(5)]

Recommendation
.**All personal protective equipment must:-**

- be appropriate for the risks involved, without itself leading to any increased risk
- correspond to existing conditions at the workplace
- take account of ergonomic requirements and the worker's state of health
- fit the wearer correctly after any necessary adjustment.

The employer must provide the appropriate equipment free of charge and must ensure that it is in good working order and hygienic condition.

Where the presence of more than one risk makes it necessary for a worker to wear simultaneously more than one item of personal protective equipment, such equipment must be compatible.
Personal protective equipment is, in principle, intended for personal use. If the circumstances require personal protective equipment to be worn by more than one-person, appropriate measures shall be taken to ensure that such use does not create any health or hygiene problem for the different users.

The Directive also stipulates that the employer is required to provide work-based training on the use of the PPE.

Face Masks
The EN14683 standard for surgical masks, covers those used for surgical operations.
The primary purpose of a surgical mask is to provide protection for the patient from the surgical team. Recently, masks have been advocated as a barrier to protect the surgical team from the patient (6)

The surgical mask is designed to avoid, during exhalation by the wearer, the projection of secretions from the upper airways or of saliva, which could contain infectious agents that can be communicated by the "droplet"(particles > 5 µm) or "air" (particles < 5 µm) transmission modes.
When worn by the caregiver, the surgical mask prevents contamination of the patient and the nearby environment (air, surfaces, products). When worn by a contagious patient, it prevents the contamination of his/her friends and family and of the nearby environment. (7)

The mask should be worn in restricted zones of the operating room, wherever there are open sterile supplies or in whichever zones or situations, local policy demands. The mask should cover the nose and mouth and should be tightly applied to the face and chin. Masks shall be changed between procedures, or immediately if they become soiled. The mask should not be handled when it is in place, as touching the surfaces will enable moisture and bacteria to wick through. It should not be worn at any time around the neck, and should be handled by the ties, when being disposed of, so as not to contaminate the hands. It should not be stored in a pocket, when not in use. (8)

Eye shields and Eye Protection
Protective eyewear should be in place when there is any risk to a staff member of splashing or spraying by blood or body fluids. There are a few different models available, some are single use and others are re-usable. Devices include goggles in a variety of designs, glasses with side shields, masks with face shields attached to the top of the face mask and face shields that are worn

on the head with the mask extending downwards to the chin, to protect the eyes and the mouth from splashing.
Staff members who wear spectacles, glasses or contact lenses will need to find a specific model of eye protection which is compatible with their products. They need to be properly protected from any potential splash, in the same way as any other member of the surgical team.
Goggles should fit snugly, especially at the corners of the eye and across the brow. They should have anti-fog properties and may also need to be indirectly vented. Many different models exist.
Non disposable eye protection should be washed between uses and kept clean. (9)

Gloves
Staff should be aware of the proposed use for the gloves required and the uses, types, and limitations each type of glove material may have, when the glove selection is made. Gloves – examination

Examination gloves are usually chosen to protect the healthcare workers hands from contact with potential contamination by blood and body fluids. Usually they would be selected for short, non-critical healthcare activities, but where some protection is required.
Strength, durability, and glove thickness are primary factors to consider when choosing a glove for barrier protection. [10] Gloves are made from a wide variety of different products, in a variety of strengths and thicknesses suitable for several different healthcare situations. They should systematically be worn during any care for which the caregiver's hands have any lesions (cuts, wounds, abrasions, or dermatitis) [11]

Wearing of gloves is not a substitute for hand hygiene, and when gloves are removed, hand hygiene should be undertaken.

Gloves- Surgical
Sterile gloves should be visually inspected immediately they are placed onto the hands following a surgical hand scrub and before contact with any sterile items. Powder free gloves are recommended as powder has been shown to be a cause of surgical adhesions.[12] Gloves may have tears or perforations that occur during the manufacturing process or as gloves are donned. [13] Breaches in the glove barrier, pose a risk of transmission of blood borne pathogens and an increased risk of surgical site infection. During a long surgical procedure, the effectiveness of the hand scrubbing process reduces, and hands become re-colonized by transient bacteria. Thus, if a small perforation occurs, those bacteria may contaminate the wound. A team member who realizes that a glove has a tear or small perforation, should ensure that it is changed as soon as possible.
Tanner and Parkinson in their 2003 Cochrane review concluded that double gloving significantly reduces perforations of the innermost glove. Double gloving is recommended practice. Evidence suggests that double gloving/ indicator gloves (where colored gloves are worn underneath gloves) or glove liners significantly decrease the risk of perforations to the innermost pair. [14]
Sterile gloves should be changed

- after each patient contact.
- when a visible defect is noted.
- when suspected or actual contamination occurs
- when a suspected or actual perforation occurs

There are a variety of different described techniques for applying or donning gloves being particularly open and closed methods are described. The single most important factor is that the glove needs to be applied in an aseptic manner.

Gowns
Europe has recently determined standards for re-usable and single use drapes and gowns as well as clean air suits. EN13795 also cites appropriate standards for single use products in the same range, crucially identifying that they are all medical devices. The standard determines the number of re-uses that a product may have before they become worn and no longer can be guaranteed to show a premier performance.

There should be a tracking process in place to ensure that it is known how many re-uses each reusable drape or gown has had, so that it may be discarded after the requisite number of uses. [15]

EN 13795 states "The use of surgical gowns with resistance to the penetration of liquids can diminish the risk to the operating staff from contact with infective agents carried in blood or other body fluids."

Drapes and gowns should be resistant to liquid penetration, and resistant to microbial penetration with a minimal release of particles (i.e. linting). [16]

Single use drapes and gown are available sterile in many varieties of shape, size and materials. Many are multilayered products which do not allow the passage of bacteria.

Surgical gowns once applied to the wearer are not considered to be sterile all over. The gowns are said to be sterile from the waist of the wearer, in the front, up to within a few centimeters of the neckline. On the arms, the wrist to the elbow on the upper side of the material is sterile. [17]
That implies that the back of the gown, which has been done up by a circulator, the armpits and anywhere lower than the waist are not sterile.

Sharps management
Operating rooms are one of the highest risk areas of the hospital for sharps. Not only are there a great many sharps of different types, such as needles, blades, glass ampoules but also there is potential exposure to a great deal of blood in this environment.
It is essential therefore that good practice is upheld, with local policies strictly enforced to prevent healthcare worker exposure to blood borne viruses. Reporting of needle stick injuries is also a huge problem across Europe and is subject to a new Directive, which mandates increased education for all workers.
Staff should respect the potential of each patient to be a hidden microbial biohazard and using standard precautions effectively gives the staff member a generic and basic level of safety.
The purpose of the Directive (2010/32/EU) is to implement the Framework Agreement so as:

- to prevent workers' injuries caused by all medical sharps (including needle sticks);
- to protect workers at risk.
- to set up an integrated approach establishing policies in risk assessment, risk prevention, training, information, awareness raising and monitoring;[18]

Considerations for local policy
A local policy for wearing of surgical masks in specifics areas of the perioperative environment should be available to all staff.

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European Operating Room Nurses Association

EORNA best practice for Infection prevention

Statement
Perioperative staff and all members of the team should provide an environment which is clean and safe for the surgical intervention. All practice should be guided by evidence-based practice as far as possible as well as being systematic in approach. In addition, staff should be aware of protecting their own health status and ensuring continuous monitoring. Despite great advances in infection control practice and knowledge, patients continue to be caused harm by their surgical intervention.

Key words
Infection prevention, surgical site infection, hand hygiene , skin. Drape

Purpose/objective
It can be seen that harm caused by surgical site infections (SSIs) is high and prevention practices within operating rooms should identify that perioperative nurses and other members of the team can do a great deal to reduce infections by the way they adhere to best practice.

Surgical site Infections are defined as infections occurring up to 30 days after surgery , or up to a year in patients who have implants which affect either the incision, or deep tissue at the surgical site. The infections can be superficial or deep incisional infections or more seriously in organs or body spaces. In addition to increased morbidity and mortality, SSI affects the length of hospital stay and consequently healthcare costs. [(2)]

Surgical site infection prevention measures focus on reducing opportunities for microbial contamination. Specific methods for preventing SSIs include adhering to sterile technique, implementing environmental cleaning protocols, using appropriate barriers and surgical attire, performing proper skin antisepsis and hand hygiene, minimizing traffic in the operating room during surgery, using adequate sterilization methods and treating carriers of Staphylococcus aureus pre-operatively and using preoperative antimicrobial prophylaxis.[(3)]

In addition to the above practice related factors, there are also procedure related factors which include poor surgical technique, the duration of the operation, the quality of pre-operative skin preparation and inadequate sterilization of surgical instruments.

Introduction
In a recent study of hospital associated infections (HAI) across Europe, the continuing problem can be identified by the data. The prevalence of patients with at least one HAI in acute care hospitals in the Point Prevalence Survey sample was 6.0% (country range 2.3%–10.8%). When extrapolated to the average daily number of occupied beds per country obtained by national questionnaire, the HAI prevalence was estimated at 5.7%.Of a total of 15, 000 reported HAIs, the most frequently reported HAI types were respiratory tract infections (pneumonia 19.4% and lower respiratory tract 4.1%), surgical site infections (19.6%), urinary tract infections (19.0%), bloodstream infections (10.7%) and gastro-intestinal infections (7.7%), with Clostridium difficile infections accounting for 48% of the latter. Twenty-three percent of HAIs (n=3503) were present on admission. One third of HAIs on admission were surgical site infections. (1)

Sources of potential infection

The source of the pathogens that cause most surgical site infections is the endogenous flora of the patient's skin, mucous membranes, or hollow viscera. When a mucous membrane or skin is incised, the exposed tissues are at risk for contamination. The organisms are usually aerobic Gram-positive cocci (e.g. staphylococci) but may include fecal flora when the incision is made near the perineum or groin.

Bacterial contaminants may also enter the wound from exogenous sources, including the air in the operating room, instruments, prostheses or other implants or the surgical team that meets the wound. (4)

Recommendation

Role of staff

All staff who undertake any activity relating to the patient during their surgical journey should be aware of local policies, should keep up to date with recommended practices and ensure that they all contribute to a reduction in the potential for the development of surgical site infection. Team goals should highlight opportunities for best infection control practice.

Ward staff contribute to good preoperative preparation of the patient, including ensuring that patients are bathed either the day before or on the day of surgery according to recommended local practice. The evidence cited for not shaving the patient preoperatively, other than if it must be removed, is strong and should only be undertaken using clippers rather than a razor. If shaving has to take place then clippers have to be used. Staff should ensure that the clipper head is single use and the activity is undertaken on the day of surgery. (5).

Perioperative staff should work together with the surgeons and anesthetists to ensure that best practice regarding infection prevention practice is adhered to. A culture of safety is created through:-

- management initiatives that improve patient and health care personnel safety
- health care personnel participation in safety planning
- the availability of personal protective equipment for the identified tasks
- the influence of group norms regarding appropriate safety practices, and
- the facility's socialization process for new staff

A culture of safety has a direct effect on preventing transmissible infections. (6)

Role of the patient

The patient may be asked to prepare themselves according to specific policy for pre-operative bathing, stopping smoking or remaining warm before they are admitted to the operating room. Good preoperative instructions, preferably written, should ensure the patient contributes to their own wellbeing and good post-operative recovery

Patient's clothing in the operating room

Depending on the type of surgery, opinions tend to differ. The French Society for Hospital Hygiene recommendations specify that, following the preoperative shower, the patient be dressed in clean, if possible non-woven, clothing. Others consider that the patient could re-dress with his/her own clothes. In many European countries it is customary for the patient to be transferred to the operating room in specific attire. The 2008 NICE recommendations on surgical site infection recommend that the patient be dressed in specific attire, to simplify care in the operating room, adding that the comfort and dignity of the patient must be respected.(7)

Policy and education
Each operating department should have a policy regarding recommended best practice according to national and international evidence; it should be regularly reviewed and updated as required. Regular audit of practice assists the team to ensure that they are meeting requirements. Good relationships with members of the Infection Control team are helpful to guide perioperative teams. New staff should have education on infection prevention practice as part of their induction programme and this should be reinforced each year with regular updates.

Hand hygiene and surgical hand antisepsis
Appropriate hand hygiene at every occasion determined by staff activity should be undertaken according to local and national policy.

Antimicrobial practices
Health authorities are concerned about the use and abuse of antimicrobial practices which may lead to an era when antibiotics are less able to be used to prevent infections. Antibiotic prophylaxis has the most evidence to support its use in the prevention of surgical site infection. Perioperative staff should contribute to effective antimicrobial administration by collaboration with other team members to ensure they are given within 60 minutes of the primary incision being made. [8]

Decontamination and sterilization
European standards for appropriate means of decontamination and sterilization of reusable surgical implements including instruments and equipment should be adhered to. Staff should maintain their knowledge of requirements and standards to ensure their practice is up to date. Close collaboration with specialist staff in the central sterile service areas will enhance the service to the patient and reduce opportunities for infectious transmissions.

Patient Warming
Hypothermia during surgery increases the risk of a patient getting a surgical site infection by up to three times. Every means within the team's control should be used to ensure that the patient does not become hypothermic during surgery. This may indicate changing the temperature of the operating room upwards, whilst the patient is prepared and draped, when it may be reduced for team comfort. Extra warm blankets may be used for the patient. There are many different technologies available to keep patients warm including convection mattresses, forced air warming, water mattresses and others, which should be used to keep the patient warm. Recommended practice suggests that patient warming

EORNA recommended practices for theatre attire should be adhered to. The use of masks that cover the mouth and nose, hair coverings such as caps, sterile surgical robes and impermeable sterile gloves is standard for surgical teams. Some correspond to basic principles of aseptic technique although evidence on direct links to rates of surgical site infection is not available or has been disputed. [10]

Standard Precautions
Standard precautions should be practiced within operating theatres ensuring that patients and staff are satisfactorily protected from possible transmission of infectious agents.

Personal protective equipment. (PPE)
Personal preventative equipment should be available to use by any staff member or visitor who has undertaken a risk assessment of the surgical patient and environment and wishes to use it.

Aseptic technique
All staff and surgical team members should practice flawless aseptic technique and any breaches of technique should be highlighted at any time they occur. Incident reporting mechanisms should be in place to add knowledge and learning opportunities for staff as well as data on trends.

Safe perioperative environment
Ventilation
Ventilation is used extensively in all types of healthcare premises to provide a safe and comfortable environment for patients and staff. More specialized ventilation is provided in areas such as operating departments, critical care areas and isolation facilities for primary patient treatment. Increased health risks to patients will occur if ventilation systems do not achieve and maintain the required standards. The link between surgical site infection and theatre air quality has been well established. (11)

Air contamination (inert particles and microorganisms) is the reason for using an air-conditioning system, the aim of which is to provide clean air (filtration), to avoid the entry of contaminated air from neighboring zones (over-pressure), and to draw suspended particles and microorganisms (renewal or mixing rate) towards the exterior. There is a persisting debate on the control of air flow, between a non-unidirectional (turbulent) and a unidirectional (laminar) flow. Various studies carried out in the 1980‘s in class 1 surgery, in particular involving the implantation of a joint prosthesis, suggest that the reduction in the incidence of SSI is above all related to antibiotic prophylaxis, and that the unidirectional flow provides an additional reduction only. In class 2, 3 or 4 surgery, since most infections find their origin in the patient‘s flora, the use of a unidirectional flow is thus not a decisive factor in SSI prevention.

Traffic
The purpose of controlling operating room traffic (that is movement within the operating room), is to minimize the movement of bacteria from the theatre environment itself, perioperative personnel and patients. Each perioperative environment has established traffic patterns which relate to unrestricted areas where traffic is not limited. In semi-restricted areas, traffic is limited to authorized, correctly attired personnel and patients. In the restricted areas, traffic is extremely limited, and personnel must be correctly attired. This includes the operating room. In addition, there should be only the number of staff required to manage the patient safely within the operating room, and their movement and talking should be minimized.

The doors to the operating room should remain closed to ensure effective ventilation of the area. As far as possible all supplies and equipment required for the patient or operating list should be available in the operating room prior to the case commencing. This will reduce the traffic in and out of the room and therefore maximize the efficiency of the ventilation system. (13)

Cleaning
The surfaces in operating rooms should be kept clean using water, detergent and wiping. As surfaces are considered ‘non-critical’ according to Spaulding’s classification system, keeping them clean should be enough for safety. Use of disinfectants, either in a cleaning solution or vaporized into the air, has not proven to make a difference in the rates of surgical site infections and can pose risks to healthcare workers, although throughout the world, this standard is universally practiced. (14) There should be a local policy for cleaning the operating room and adjacent areas devised in collaboration with the Infection control team and housekeeping services.
Specific spillages of blood or body fluids should be cleaned separately and be subject to local policy recommendations.

Microbiological Commissioning and monitoring
Conventionally ventilated operating theatres must be commissioned before being used, after being built or modified substantially. `The level of airborne bacteria introduced by the supply air can be checked by closing all doors and leaving the operating room empty with the ventilation system running for one hour, after which a bacterial sampler mounted on the operating table should be activated remotely. Aerobic cultures on non-selective medium should not exceed 35 bacterial and/or fungal particles per cubic meter of ventilating air.

The most appropriate time for microbiological commissioning of an operating theatre should be shortly before it comes into use. The theatre should have had an `in-depth' clean and be thoroughly clean and dust-free. The air handling unit (ventilation unit) should have been operating at normal flow rates (i.e., not on setback ventilation) continuously for at least 24 hours before sampling. Given the usual timeframe for sampling, it is usually only the production of satisfactory microbiological sampling that is required to enable a new or refurbished theatre to come into use.

Ultra Clean units (or Laminar Flow) operating rooms also need to be tested to ensure: 1- that the velocity of air within the clean zone is sufficient to result in a robust, unidirectional flow capable of resisting ingress of contaminated air from outside the zone; 2- that filters are intact and properly seated so as to remove microbial contamination from both incoming and re-circulated a

Routine monitoring
Provided that engineering parameters are satisfactory and regularly monitored microbiological air sampling in conventionally ventilated theatres need not be done on a routine basis, unless by local agreement. Microbiological air sampling of empty, conventionally ventilated theatres should be done either as part of an investigation into theatre acquired infection with a possible airborne element or after any changes that may affect airflow supply rates or distribution patterns.

The pattern of airflow in an Ultra Clean Ventilated (UCV) theatre should be stable given reasonably constant air velocities. The recommendation is that they are monitored annually or at hepa-filter replacement or disturbance. It is recommended that, in empty UCV operating rooms, such testing is best accomplished by using inert particles rather than by bacteriological testing. [16]

Waste Management
Waste management in hospitals is subject to the EU Waste Framework and requires that any potentially hazardous waste from the operating rooms or hospital is segregated, color coded and disposed of in accordance with legislation on waste management.
Most waste coming from operating rooms will need to be incinerated to dispose of it safely and to reduce opportunities for cross contamination. Local policy will assist practitioners to manage their clinical waste appropriately.

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EORNA best practice for skin preparation and draping

Statement
In preparation for surgery, microorganisms are removed from the patient's skin to reduce the opportunity for surgical site infection. This is usually undertaken in two stages, first on the ward and then as part of creating the sterile field, before the first incision is made. Recommended practices all indicate that a pre-operative bath or shower is an effective first stage of pre-operative preparation for the patient, either on the day before or on the day of surgery.(1) For preparation of the skin once the patient is in the operating room, there is considerable debate in the literature around whether one specific antiseptic is more effective than another and also the method of application. The prepared area should be large enough to permit extension of the incisions, potential shift of the drapes and placement of drains. (2)
Following skin preparation, the patient will have their planned incision site isolated by sterile drapes, which form the sterile field.

Key words
Skin preparation, antiseptic , clean, risk, clipper

Purpose /objective
The efficacy of antiseptic agents is dependent on the cleanliness of the skin. Removal of the superficial soil, debris, and transient microorganisms before applying antiseptics reduces the risk of contamination of the wound, by decreasing the organic debris on the skin.

Introduction
The World Health Organization (WHO) includes minimizing the risk of SSI as one of their ten essential objectives for safe surgery, but do not recommend a specific skin preparation agent.(11) The National Institute for Health and Care Excellence Guidelines (NICE) recommend using an antiseptic preparation – with either povidone–iodine or chlorhexidine being the most suitable, with no evidence of superiority of either agent.(12) The Cochrane Review Group concluded that there was limited quality evidence regarding preoperative skin preparation in clean surgery but suggested that there was some evidence from one study that chlorhexidine 0.5% in methylated spirits was associated with lower rates of SSIs following clean surgery than alcohol-based povidone iodine paint.(13) However, in clean-contaminated surgery there is evidence to support chlorhexidine over povidone-iodine.(14–16) Darouiche et al recommend 2% chlorhexidine in spirit as being the most effective to reduce the potential of surgical site infection. (17)

Some anatomical areas contain more debris than others, e.g. under fingernails, the umbilicus, under foreskin. These areas should be cleaned separately. Cosmetics on the skin may prevent the antiseptic agent from being effective. (18) If there is to be more than one operation site, the cleanest should be prepared first. Areas which are highly contaminated such as the perineum, anus, vagina, and axilla should be prepped last. (19)

Recommendation
Skin Preparation
The removal of transient bacteria and reduction of the number of commensal organisms by an antiseptic is recommended prior to surgery by cleansing the skin at the operation site with an antiseptic. It mechanically removes, chemically kills, and inhibits contaminating and colonizing skin flora. Endogenous skin flora has been identified in many surgical site infections (SSIs). Antimicrobial

agents with sustained effect should be used to reduce the endogenous flora. The perioperative nurse/ practitioner should ensure that the preoperative antimicrobial agent used should:-

- Contain broad spectrum properties
- Significantly reduce microorganisms on intact skin
- Be non-irritating and non-toxic
- Be rapid acting
- Have a persistent effect [3]

Persistence of the antimicrobial effect suppresses the re-growth of residual skin flora not removed by preoperative prepping, as well as suppressing transient microorganisms contacting the prepped site. [4] Selection of the antimicrobial agent is based on:-

- Patient allergies and sensitivity
- The operative site
- Condition of the patient's skin
- Presence of organic matter, including blood
- The surgeon's preference

The same agent shall be used for all phases of the patient's skin preparation to ensure full residual benefit and consistent action. [5] An indelible skin marker should have been used to mark the patient's operative site, so that it is not washed away during skin preparation. [6]

Preoperative hair removal

Hair removal is only necessary if it will directly interfere with access to the incision site, or if there is a risk it will contaminate the wound site. The use of depilatory creams is an effective method of hair removal causing significantly fewer surgical site infections than shaving with a razor [7]. Hair removal at the operative site, if performed is undertaken as close to the time of surgery as is practical, in a semi critical location, outside the operating room where the procedure is to take place. Skin integrity will be preserved using clippers with disposable blades. [8]

Skin preparation agents

The most used skin preparation solutions in Europe are based on aqueous or alcoholic solutions containing either chlorhexidine gluconate or iodophors (comprised of free iodine molecules bound to a polymer: usually named povidine- iodine). [9]

Antiseptic agents used on the skin of patients with known hypersensitivity reactions (i.e. allergies) may cause adverse outcomes in the form of rashes and blistering. Some agents are affected by organic matter and or saline and may be rendered less effective. Some may be absorbed by the skin or mucous membranes and become neurotoxic or ototoxic. Certain antiseptic agents are believed to be potentially harmful to neonates. Products made specifically for use on mucous membranes should be used following manufacturers recommendations [10]

Method of application

The efficiency of cleansing does not depend exclusively on the skin preparation solution used; recommended practices also refer to the technique used to apply the chosen skin preparation solution. [20] AORN suggests one of the circulating team undertakes the skin preparation with gloved hands. [21] This is not the technique usually used in Europe where often the scrub nurse/ practitioner or the surgeon using a sterile swab on a sponge holder undertakes the skin preparation, and may repeat the application with clean swabs until satisfied that the whole site has been prepared.

Solutions should not be allowed to form a pool either underneath the patient or in the umbilicus due to the danger of fume evaporation and potential fires. (22)

The traditional technique which has been described is that of concentric circle motion, beginning around incision and proceeding towards the edge of the area, without returning to the center. This is described by Mangram et al and others. (23) However, more recently Hadaway suggested that a method which employs a back and forth scrubbing technique has been shown to be more effective and that it is replacing the former method. (24)

Whichever antiseptic agent is selected, and whichever technique is used, by whom, the manufacturer's instructions for contact time are most critical. There should be sufficient time for the agent to work on reducing the skin flora by contact, there should be drying time to enable the persistence to occur and vapors dissipation reduces the likelihood of causing the patient skin irritation, as well as preventing fire and burn injuries. It is also recommended that the agent should not be physically dried after the application with a swab, as this reduces the efficacy of the antimicrobial solution. (25)

Skin antiseptic agents should be stored in their original containers, which should not be refilled and used within date. Ideally, antiseptics should be supplied in ready-to-use, single use containers or sachets, as there is an increased risk of contamination from using multiple use containers.(26) Solutions should not be warmed unless recommended by the manufacturer. (27)
Skin preparation details should be documented as part of the surgical record of the patient's care.

Draping the patient
Surgical drapes are single use or re-usable materials which are used to cover the area around the incision site to create a sterile field. The process of draping occurs after the patient has been safely positioned on the operating table and their skin has been cleaned using an antiseptic, as above.

The team create the sterile field by laying drapes onto the patient and equipment which will be moved close to the operating table to form part of the sterile field i.e. the mayo table and instrument trolleys.

EN 13795 identifies the standards in Europe which need to be met by the materials used, whether they are single use or reusable. One of the key requirements is that the drape used, provides a barrier which prevents bacterial strikethrough and contamination of the sterile field, thus reducing the opportunity for surgical site infection. (28)
Sterile drapes, which conform to EN13795 should comply with the following characteristics:-

- Providing a barrier against fluids (be resistant to strikethrough)and microorganisms including viruses even when wet
- Being lint and particulate free-lint and other particulates can contaminate the wound and cause infection or delay the healing process
- Not containing toxic substances such as laundry residues or non-fast dyes
- Assisting in maintaining the patient's body temperature
- Being resistant to tearing
- Preventing glare from reflected light
- Being easy to use and conforming to the patient and equipment
- Being fire retardant and anti-static. This is especially important during the use of electro-cautery, lasers, fiber optics and other electrical equipment. Manufacturers should adhere to fire regulation standards.(29)

There are many different types of drapes available to use. Selection usually involves a member of the surgical team, the budget holder or theatre manager and an infection prevention specialist. Some of the drapes available are manufactured for specific surgical operations such as hip drapes – often these are made as the area which needs to be draped is difficult to get coverage. Isolation drapes are also available which are often transparent and are used to enable the surgical team to handle an item, such as a microscope or light lead. Adhesive drapes are used to fix the drapes into position although there is little evidence of their benefit in reducing surgical site infections. [30].

When re-usable drapes are chosen, there needs to be a tracking system in place, so that the number of cycles of laundry can be counted and the drape replaced at the end of the cycle. 75 washes are the guidance issued to teams after which the moisture barrier is likely to be compromised – however this will differ from one material to the next.

Disposable drapes are available pre-sterilized from the manufacturer or unsterile to be included in packs in the sterilization process. The main consideration is the cost of disposal.

The process of draping

The area around the operating table and the patient, should be as free of equipment as possible, to prevent contamination of the drapes during draping. Any equipment required for the procedure should be moved into place once draping has taken place. [31]

Drapes should be handled as little as possible, and not fanned or waved in the air. [32]They should be held higher than the surgical site and placed in a controlled manner. Sterile gloved hands should be protected by 'cuffing' the drape over hands. While draping, gloved hands should not touch the skin of the patient [33].

The area which is draped first is that closest to the incision site, moving outwards. Team members draping the patient should not lean across a non-sterile surface, as their gown may become contaminated. Once the drapes are in position, an adhesive drape may be used to fix them in position around the incision site or non-perforating towel clamps may be used to secure them and other equipment such as tubing.

At the end of surgery

Before the scrub nurse/ practitioner takes off their gown and gloves, they should take away all items from the sterile field and remove the contaminated drapes into a laundry basket or contaminated waste bag, according to the type of drape that has been used. [34]

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European Operating Room Nurses Association

EORNA recommendation for aseptic technique

Statement

Asepsis is the absence of microorganisms [1]. Aseptic technique is practiced by perioperative personnel including the surgical team to reduce opportunistic infections caused by transmissible microorganisms during surgery. The basic principles of aseptic technique are to create and maintain a sterile field, prevent contamination of the wound, isolate the operative site from the surrounding non-sterile physical environment so that surgery can be safely performed.

Key words

Asepsis, aseptic technique, sterile filed ,surgical wound, contamination

Purpose/objectives

Reducing the opportunities for contamination of the surgical wound by team members during surgery requires a set of rules and practices which protect the patient and the environment from possible microorganisms which can cause surgical site infections. This practice is aseptic technique, it is the core of surgical practice and it requires all members of the team to be vigilant for breaches of the standards.

Introduction

Surgical site infections in European Union (EU) as reported by European Centre for Disease Control (ECDC) are common infections. Whilst perioperative practices have not been specifically identified, they inevitably contribute to the incidence of infections.

A point prevalence survey undertaken in Europe during 2010, found that across 66 participating hospitals in 23 countries, that 7.1% of patients had a healthcare- associated infection (HAI). Of those reported, surgical site infection was the second most identified infection at 18.9%. [2]

Environment suitable for surgery

A suitable environment for surgical intervention should be created and requires control, maintenance, and monitoring. Parameters should be maintained for ventilation ensuring the atmosphere has a change of air in the volume of the operating room of at least 25 air changes per hour and that the temperature is also able to be controlled to be within 18-25°C. EU standards for ventilation are relatively recently reviewed in 2007 (3). The document identifies that in modern practice, there is no need to regulate humidity in an operating room. Orthopedic operating theatres or those where prosthetic implants are put into patients, frequently utilize ultraclean ventilation (also known as laminar flow) where the air changes may be 300-500 air changes every hour and are much greater in terms of a more organized air flow at the operating site with the supply air being high efficiency particulate air (HEPA)-filtered.[4]

Recommendation

Establishment of a sterile field

The scrub nurse/practitioner who will create, guard, and maintain the sterile field will have performed the surgical hand antisepsis procedure “scrubbing up” and be gowned and gloved appropriately for surgery. Scrubbed personnel will not touch any item which is considered potentially unsterile. They will ensure that their hands and forearms always remain above waist height . When passing another scrubbed person, they will maintain sterility by passing face to face or back to back. [5]

A wide margin of safety should be given to the sterile field, once it has been created, so for example there should be no unexpected movement of unsterile personnel close to the sterile field. Unsterile personnel should give a clearance of at least 30-35cm from any sterile item.
The trolley on which the sterile field is to be created will be clean, dust free and have been cleaned with spirit (with a product approved for the purpose) before and after use. The sterile field will be created by placement of a sterile drapes on to trolleys and then to the surgical site. The packaging material should be impermeable to liquids including blood and body fluids and meet the requirements of EN 13795[6].

Once the packaging has been opened and drapes cover vertical and horizontal areas, the horizontal surface only, is the part of the sterile field, which is considered sterile. Any item which falls away from the surface, wholly or partially from the horizontal, shall be declared unsterile. If there is any doubt about sterility, then the item must be replaced and not used.
Sterility is event related and depends on the maintenance of the integrity of the package [7]

The sterility of an item does not change with the passage of time but may be affected by events such as the amount of handling or environmental conditions or being dropped onto a surface causing micro tears in the packaging. These items should be discarded, and another packet/set opened [8].

Instrument tray opening
The instrument tray opening, due to its' weight, is often the first item to be opened to create the sterile field. The tray may be conventionally wrapped and opened to create a sterile field or a rigid instrument container which needs to be placed onto a sterile covering on a trolley, or its contents. The rigid instrument containers and conventional trays should be checked to ensure that the sealed tags indicating that they have not been tampered with are intact, and expiry dates are acceptable for use. In addition, the conventional sterilized package will have an external chemical indicator and sterile tape, which should be checked to ensure that they have been sterilized. [9]

Sterile supplies are dispensed onto the sterile field.
All sterile supplies, equipment and instruments are opened for use and are checked and recorded according to local policy for documentation and traceability. They are opened as close to the time of use as possible and must not be set up in advance and covered. Only items that are sterile can be added to the sterile field.

Aseptic means 'without microorganisms. All items added to the sterile field shall be assessed prior to opening for sterility by checking for visible signs of moisture, wrapper integrity, changed chemical indicators, tamper proof devices such as sticky tape or also more complex closure devices. Expiry dates shall also be checked and will be within manufacturers given dates. Items should not be used after the labelled expiration date. Perioperative personnel should inspect the sterilization chemical indicator in the sterile package to verify the appropriate color. [10]

Sterilized packages which are unwrapped by the circulating person, using the furthest wrapper first to cover their hand, then each side flap is opened and secured in the hand followed by the nearest wrapper. The item is presented to the scrubbed person to take in a sterile fashion using their gloved hand or an instrument for transfer to the sterile field. Peel pouches are opened so that each layer reveals the inside only of the package. The wrapper is secured in the hand, while the item is presented to the sterile field, sticking out of the package, to be taken by hand. [11]

Heavy items which are to be opened for the sterile field, should be unwrapped in a sterile fashion by the circulating nurse/ practitioner and presented to the field to be taken by hand, by the scrubbed person. Alternatively, they may be placed on a trolley and opened there. Items should not be flipped onto the sterile field, as they cause air turbulence close to the field and risk contamination. [12] Some wrapped items can be difficult to open; they should be handled with care so as not to waste the contents as mishandling causes contamination.

Fluids to be dispensed onto a sterile field should be poured gently with the label on the upper side, without splashing into the receptacle which has been placed at the edge of the sterile table. The scrubbed person checks the fluid is what they expect it to be and the expiry date and the circulating person identifies and checks the fluid to ensure its appropriateness for use and the expiry date.

Liquids in multi-use containers are not considered sterile once the cap has been replaced onto the bottle. [13]

If medications or solutions are to be used on the sterile field, their details must be checked and labelled once they are on the sterile field using sterile labels in the interest of patient safety. Expiry dates must also be checked.

Sharps being opened onto the sterile field should be opened into a receiver, so that they do not penetrate the surface of the sterile field and can be monitored at all times, to reduce the opportunity for a sharps injury. [14]

Patient preparation prior to sterile field creation for the surgical site
The draped patient is an important and integral part of the sterile field. Care should be taken to ensure that sterility is maintained during the draping process. The scrub team, draped patient, equipment and instrument trolleys assembled together form the large sterile field around the patient's wound site. Draping and Skin preparation are part of this essential patient preparation.

Monitoring of the sterile field
Once created the sterile field should be monitored at all times and not left unattended, when it is possible any contamination might take place.[15] The scrub nurse is responsible to ensure that the sterile field is managed and monitored at all times to ensure that there is no possibility of contamination. It should not be left unattended at any time.

If organic matter or any other debris is detected on the sterile field, which may come from inept cleaning of instrumentation, the whole set of instruments and the sterile field should be considered contaminated and re-set. Instruments which are contaminated with debris etc. should be considered unsterile and removed. Where this contamination is part of a set then the instrument set should be replaced. Local policy should identify the procedure to undertake and the reporting mechanisms required in this instance. [16]

Principles or considerations for local policy.
Nonconformance with required instrument cleaning standards and reporting mechanisms for patient safety.
Perioperative Care record – does it include all items opened onto the sterile field. Extra instruments should be recorded, as well as the trays of instrument. All identifier labels on sterile products or implants must be recorded for future traceability in case of product recall.

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EORNA best practice for hand hygiene

Statement

There is a standardized procedure for different practices of hand antisepsis for different occasions, and all healthcare staff adhere to the principles and practice to reduce the potential of transfer of microorganisms via the hands of the worker.

Key words

Hand hygiene , microorganism, alcohol

Purpose/objectives

Hands are the most common source of micro-organism transfer from one place to another or one person to another, potentially causing disease. Patients are particularly vulnerable, and we owe them a duty of care not to increase their disease burden by poor practice. Hand washing to remove the transient and resident microorganisms is therefore the most important action anyone can undertake to avoid the transmission and reduce the opportunity for healthcare associated infections. [(1)] Healthcare associated infections can cause untoward patient outcomes such as the escalating cost of care, extended stay in hospital, additional medications, and pain and suffering as well as possible death.

Introduction

In 2009, The World Health Organization (WHO) Patient Safety Alliance made evidence-based recommendations available for the appropriate indications for hand hygiene [(2)]. They have been accepted all over the world and are now used universally. Perioperative hand washing is an important aspect of infection prevention and should be undertaken by all members of the surgical team.

Recommendation

Alcohol based hand rub

If hands are not visibly soiled, an alcohol-based hand rub may be used. It is described by WHO [(3)] as the preferred means of routine hand antisepsis. Local protocols should exist to describe the exact technique and time which should be taken to use the hand rub effectively, using evidence-based research and the manufacturer's guidance [(4).] Essentially, hand rub should be used in sufficient quantity to cover all the surfaces of the hands and towards the wrists. These areas should be rubbed together until they are dry.

Hand washing

Soap and water should be used to reduce soiling, and organic matter as well as microorganisms from hands, fingers, and nails [(5).]

A local policy based on WHO recommendations for the technique and time taken should be available in the hospital. The generic technique identifies that hands should be wet by the water before soap is applied. Add soap, using the appropriate volume of product necessary to cover all surfaces. Ensure soap is in contact with the skin for at least 15 seconds to reduce spores, soil and microorganisms [(6).]

Rinse hands with water, and dry thoroughly with a single use towel. Use clean running water at a comfortable temperature. Avoid using hot water, as repeated exposure to hot water may cause dermatitis. Use a towel to turn off the tap if an elbow operated tap in not in place [(7).]

Dry hands, so that there is no opportunity for a transfer of microorganisms from the hands to surfaces in the environment, in any remaining moisture. [(9)]

Liquid , bar, leaf, or powdered forms of soap are acceptable. When bar soap is used it should be able to be dried between uses in a rack.

'Five moments for Hand Hygiene' is a useful reference for practitioners, placed beside hand washing sinks [9]. A further useful poster is the areas of the hand which are most frequently missed when hand washing [10].

Surgical Hand Antisepsis

Scrubbing is an extension of hand hygiene described above. The purpose is to reduce the release of skin bacteria from the hands of the surgical team for the duration of the procedure in case of an unnoticed puncture of the surgical glove releasing bacteria into the open wound. [11] The most used liquid soaps for scrubbing are chlorhexidine gluconate and povidine iodine. Almost all studies discourage the use of brushes on the skin of the hands during the process of surgical hand antisepsis, but sponges may still be used [12]. A supply of clean running water is essential to the process as each scrub tends to use up 20 liters of warm water. However, alcohol-based hand rubs have also been used for pre-surgical hand preparation and have been shown to be as effective, in reducing bacterial load – if not more so, than medicated soap antisepsis [13]. Both methods are suitable for the reduction of surgical site infections [14].

All individuals who are going to scrub up, wear a sterile gown and be part of the sterile field should be properly attired before they approach the sink to scrub their hands.

Fingernails should be short, so that there is less opportunity for bacteria and soil to remain under the nails during the scrubbing process. The best method for removing soil from under the nails is by using a single use nail pick. Longer nails are also more likely to cause tears in gloves. Artificial nails and extensions to existing nails are not recommended for use by healthcare professionals due to the resin which binds them to the nail bed. Studies have identified larger numbers of micro-organisms harbored in false nails [15]. Fingernail polish which has become chipped or worn also harbors a greater number of pathogens [16]. Rings on fingers have also demonstrated a raised number of skin micro-organisms. [17] Watches and bracelets should be removed before scrubbing. [18]

Standardized technique for hand scrubbing.

Studies have shown that effective hand antisepsis can be undertaken between 3 and 5 minutes and that longer times (e.g. 10 minutes) are not necessary [19]. Antimicrobial solutions should be in contact with the skin during the scrub process, for their antimicrobial properties to be activated. The contact time will vary from one product to another.

Procedural steps according to WHO (20) are :-

- Start timing. Scrub each side of each finger, between the fingers, and the back and front of the hand for 2 minutes.
- Proceed to scrub the arms, keeping the hand higher than the arm always. This helps to avoid recontamination of the hands by water from the elbows and prevents bacteria-laden soap and water from contaminating the hands.
- Wash each side of the arm from wrist to the elbow for 1 minute.
- Repeat the process on the other hand and arm, keeping hands above elbows always. If the hand touches anything at any time, the scrub must be lengthened by 1 minute for the area that has been contaminated.
- Rinse hands and arms by passing them through the water in one direction only, from fingertips to elbow. Do not move the arm back and forth through the water.
- Proceed to the operating theatre holding hands above elbows, unless the layout of the theatre is that you are already there.

- At all times during the scrub procedure, care should be taken not to splash water onto surgical attire.
- Once in the operating theatre, hands and arms should be dried using a sterile towel and aseptic technique before donning gown and gloves. A blotting technique is the most effective drying method. The towel should not be returned to the hand once the arm has been dried. The principle to use is that the hand remains the cleanest and the elbow the least clean throughout the scrubbing and drying process and prior to donning sterile gloves.

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European Operating Room Nurses Association

EORNA best practice for gowning and gloving

Statement

Preparation of the sterile field includes preparation of personnel who will undertake or assist with the surgery. Each person who will form part of the scrubbed surgical team will have undertaken hand antisepsis according to local policy and be gowned and gloved before they approach the sterile field. The method undertaken to wear both the gown and the gloves shall be by using a sterile technique. The gowns and the gloves will form a protective barrier to reduce the risk of exposure to blood, body fluids and other potentially infectious contaminants.

Key words

Gowns, gloves, single use

Purpose/objectives

Gowns used in surgery are medical devices and must meet the criteria set out in EN 13795. The standard requires that gowns are able to withstand the user performing all that is required from the surgical procedure without compromising the sterile field. In addition, the gown should be resistant to liquid penetration and microbial penetration, with a minimal release of particles (low linting). [(1)]
Gowns should be sufficiently sized to adequately cover the scrubbed person [(2),] including the sleeves and cuff are long enough to reach the wrist. Wrap around gowns add additional protection for the sterile field and the wearer.

Introduction to gowns

There are several different types of gowns available. Single use, disposable gowns made of non-woven polypropylene; re-usable gowns made of lightweight synthetic textiles which are reprocessed a limited number of times before being disposed of, according to manufacturer's recommendations; and linen re-useable gowns which are being gradually discontinued as they are not considered to be effective as a microbial barrier[(3)] as required by EN13795.

Recommendation

Gowning procedure

Gown selection will be determined by an assessment of the potential of the procedure for exposure to fluids and blood and bodily fluids as well as the likely length of the operation. [(4)]
On completion of the surgical hand scrub process, to put on a gown, the person should step into an area where the gown may be opened without risk of contamination. This may be close to the scrub sink or into the operating room. The gown should be presented in the sterile pack in a standardized way so that it may be lifted from the pack and allowed to unfold without contamination. The scrubbed person holds the shoulder and neck area of the gown, once it has unfolded, so that it can be carefully opened to reveal the armholes. Both hands should be slipped into the armholes and sleeves to enable the gown to be moved towards the body. The circulating person can help by touching only the inside of the gown at the back , to encase the shoulders in the sterile gown. Ties or Velcro can then be done up at the back. The hands of the scrubbed person should not be allowed to protrude from the cuff until the end of the gloving process. The wrap around tie can be handed off to the circulator, to complete the process, after gloves have been donned. [(5)]

Sterile areas of the gown.

A gown is considered only to be sterile from mid-chest to waist or table level in the front and from the elbow to the gloved fingertip. The neckline, shoulders, under the arms, sleeve cuffs and the back are considered unsterile. (6)

Should a person in a sterile gown wish to move along the sterile field, and this involves passing another gowned and gloved person, they should move, face to face or back to back, to prevent possible contamination.

Scrubbed team members should always keep their hands at or above their waist level .

Introduction to gloves

The wearing of gloves has two purposes: to provide a barrier against the dissemination of the surgeon‘s and assistant’s transient and resident skin germs and avoiding contamination of the hands by blood and exudates from the operative wound. (7) Surgical gloves should fit well to the hand for dexterity, comfort, and sensitivity. (8)

Surgical gloves are said to be ‘donned’ when they are put on. There are different described methods of donning gloves, one called the closed glove method, which is preferred as a lower risk procedure. Risk of contamination is significantly reduced when hands are covered, by the cuff / sleeve of the gown, during gloving. (9) The alternative is the open glove method, where the hand protrudes from the end of the sleeve and the glove is subsequently donned.

Assisted gloving can also take place when a member of staff needs to change a glove. The cuff of the gown is likely to be contaminated, so another person holding out a glove for a second to ‘dive into’ is thought to be the method with the least opportunity for contamination.

Sterile surgical gloves should be inspected immediately after donning and prior to any contact with sterile supplies or tissue – to be checked for tears or perforations which may compromise their sterility. (10) They should be changed immediately if they have been compromised or they become contaminated. (11)

Standards for gloves

Surgical and examination gloves should conform to the standards outlined in EN 455 and the Directive on personal protective equipment 89/686/EEC. Gloves can tear or perforate easily and the wearing of two pairs of gloves considerably improves impermeability and reduces the risk factor in the case of a needle stick into the gloves. The drawback of this approach is that of discomfort and a loss in dexterity. The wearing of two pairs of gloves may be indicated for surgical procedures with a high risk of perforation, such as orthopedic surgery, in order to protect the surgeon‘s hands, in particular for his/her protection against the risk of viral contamination.(12) Evidence supports the use of double gloving for all surgery including low risk surgery.(13)

Wearing a colored glove puncture indicator system has been shown to detect perforations in the outer glove more easily than when wearing standard gloves. (14)

Latex free gloves should be available for those with sensitization to latex and for use with patients who are latex intolerant.

Surgical gloves worn during invasive surgical procedures should be changed:

- After each patient procedure
- When suspected or actual contamination occurs
- After adjusting optic eyepieces on the surgical microscope
- Immediately after contact with methyl methacrylate
- When gloves begin to swell, expand, or become loose on hands as a result of the material’s absorption of fluids and fats

- When a visible defect or perforation is noted or when a suspected or actual perforation from a needle, suture, bone, or other object occurs , and
- According to local policy [15]

Removing a contaminated gown and gloves at the end of the procedure.
At the end of the procedure, the gown should be removed by pulling it over the gloved hands and disposing of it in the appropriate waste container. Gloves should be removed without contamination to the hands and discarded appropriately. It is essential that a social hand wash is undertaken following the removal of gloves, in line with Infection prevention protocols. [16]

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European Operating Room Nurses Association

EORNA best practice for Perioperative Attire (need to revise)

Statement

Perioperative attire will be worn when personnel enter the restricted and semi restricted areas of the operating suite. The rationale for doing this is that the surgical patient should be protected from potential contamination by exogenous micro-organisms which can cause disease and surgical site infection. Staff carry potentially harmful bacteria on their skin and street clothes and by changing their clothes contribute to a reduction in potential harm.

Key words

Perioperative attire , shoes, shoes cover, closes, laundry

Purpose/objectives

Clean freshly laundered clothing should be available for all staff and visitors to the operating room and in sufficient supply for it to be changed should it become visibly contaminated (wet or soiled) during use(1). Local policy should specify the hospitals' exact recommended practices, as these may vary according to the physical layout of the hospital and the operating room. Three named zones apply in different areas of an operating suite, which dictate different behaviors and clothing and access. There is a low evidence base for practices and in most instances , clothing specified for different areas is a matter of local discipline and should be locally defined.

Introduction

Unrestricted zones All personnel may access unrestricted zones in the operating suite and street clothes may be worn here. Some suites may have no areas that are categorized as unrestricted.

Semi- restricted zones. Traffic in these areas is usually restricted to patients and staff in appropriate clothing. Perioperative attire should be worn in these areas.

Restricted zones. These areas have the highest restriction which usually includes wearing a head covering and a face mask. The commonest designation is the operating room itself, and the instrument set up space. Wearing a mask and head cover may always be required in a restricted zone, or in the presence of an open sterile package or instrument trolley or staff who are scrubbed.

What is perioperative attire?

Attire may be a dress and pantyhose or a top and trousers, the latter are preferred as there is some beneficial reduction in skin shedding provided that the top is tucked into the trousers. Clothing should be made of close woven fabric such as cotton and polyester blend to act as a barrier to prevent transfer of micro-organisms between patients and staff. Clothing should be able to be laundered at high temperature, preferably by the hospital laundry, without shrinkage or gross deterioration of the fabric [(2)] Shedding of skin squares occurs when a person moves dispersing their normal microbial flora, which can cause harm to others and to patients, so traffic should be reduced as far as possible and should be at a measured pace (except in emergencies). Traffic restrictions and special clothing all contribute to reduction of infection risk for the patient. Any personal clothing worn under perioperative attire should be completely covered by it.

This standard covers the wearing of jewelry, head coverings and shoes as well as shoe covers. Personal Protective Equipment and clothing to be worn by the scrub team are covered elsewhere.

Recommendation

Head covers

Personnel should ensure that when they are entering a semi restricted or restricted area of the operating suite, that all their hair, including any facial hair is covered by a clean laundered hair cover or preferably a single use disposable one. This protects the patient and sterile field by reducing contamination from hair or skin shedding from the scalp or face.

The head cover should be in place before personnel put their surgical/ perioperative top on over their head to reduce the opportunity for contamination of the surgical top by their hair, which may carry micro-organisms.

Jewelry

All jewelry other than a wedding band should be removed by staff when they change into surgical attire, as it is an infection hazard. [3] Wedding bands also harbor micro-organisms beneath them, so when performing hand hygiene staff should be most particular to move the band and use soap beneath it. It is recognized that it would be difficult to get staff to remove their wedding band. All other rings should be removed.

Personnel should not wear necklaces other than single strand, gold or silver which can be contained within their perioperative attire. All other types of necklace are a source of infection as well as a potential hazard if they break close to the sterile field and should not be worn. [4]

Earrings of a simple stud design or sleepers are permitted but any others are a source of skin contamination and should not be worn. [5]

Body piercing and body jewelry harbor microorganisms and should also be removed, both from the patient if they are close to the potential wound site and staff if they are working within the restricted and semi restricted zones. [6]

Shoes

Footwear is usually provided to staff and should meet local health and safety requirements to protect staff from blood, body fluids, sharps, and chemicals in the environment as well as all the possible slippery surfaces near to scrub sinks etc. Shoes should have closed in toes, solid backs, low heels, nonskid soles and be easy to clean. Cloth shoes such as ‘trainers can harbor microorganisms and are not suitable for restricted and semi-restricted zones. [7]
Shoes should be cleaned regularly to reduce the opportunity for contamination which may cause problems to patients and especially when there is visible soiling. [8]

Shoe Covers

Shoe covers are not recommended for use. They have been shown to increase floor bacterial counts and to increase the bacterial hand count when being applied or removed. [9]

Cover gowns

If cover gowns or warm-up jackets are worn, they should be fastened. They should be changed daily and laundered in the recommended facility (not at home). [10]
Visitors requiring a short visit to part of a semi restricted area, such as parents accompanying their children to an anesthetic area or an engineer attending to maintain a piece of equipment on site should be able to cover their own clothes with a single coverall gown together with a head covering. Local policy should determine the detail.

Wearing perioperative attire outside the operating suite
There is sparse evidence that wearing perioperative attire outside the operating department increases surgical site infections [11]. If personnel leave the operating department in their perioperative attire (which may not be allowed by local policy) – it should be changed on re-entry to the operating suite for clean, freshly laundered perioperative clothing.

Designated areas for changing
Most operating suites will have designated areas for changing with secure facilities for leaving personal belongings. However, some endoscopy rooms and interventional areas, now increasingly used for 'surgery' were not built with changing rooms. Local policy should determine the details of appropriate clothing for the interventions and where personnel may change.

Laundry and disposal
Clothing used in the restricted and semi restricted areas may be single use and disposable when it should be disposed of in a suitable waste bin. Most of the perioperative attire is returned to use by the laundry, following high temperature washing, careful and thorough drying and ironing. It is folded and returned for use. It should be placed directly into the laundry bin provided in the changing room, prior to hand hygiene at the end of the working day.

Considerations for local policy
Areas which are not designated as operating rooms in hospitals but are increasingly used for major interventions by radiology, cardiology and others to minimally invasively attend to a patients treatment needs, should have appropriate attire determined by policy, using the same evidence and microbiological rationale as operating suites.

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Part 4

Pandemic disasters

European Operating Room Nurses Association

EORNA best practice for Ebola (Viral Hemorrhagic Fever)

Statement
EORNA fully supports all initiatives to promote infection prevention to ensure that infectious diseases are controlled both to protect the public and the patient population.

Key words
Infection prevention, transmission , intervention, knowledge

Purpose/objectives
In response to an extensive outbreak of Ebola (Viral Hemorrhagic Fever, VHF) in West Africa the World Health Organization has identified that while Ebola does not occur or survive naturally in Europe there is a low risk of infected persons travelling and presenting outside of the affected areas and thereby advocates alertness and preparedness for persons who with a fever and a history of travel, to, or through, the affected countries. Guidance is available from the European Centre for Disease Prevention and Control, WHO and CDC. Due to the virulence of this virus, it is important that clinical staff become knowledgeable about the methods recommended for protecting themselves from contamination and infection. This statement cannot be exhaustive; management of this disease and the guidance on personal protective equipment must be sought from hospital infection control department. Ebola viruses and Marburg virus are classified as biosafety level 4 (BSL-4) pathogens and require special containment and barrier protection measures, for people taking care of infected patients or bodies. (ECDC, 2014)

Transmission
Ebola and Marburg viruses are highly transmissible by direct contact with organs, blood, or other bodily fluids (e.g. saliva, urine, vomit) of living or dead infected persons or any soiled material. Transmission by sexual contact can occur up to six weeks after recovery. Transmission can also occur by contact with dead or living infected animals including meat (e.g. monkeys, chimpanzees, forest antelopes and bats) or visiting caves colonized by bats.

Nosocomial transmission can occur. Healthcare workers can be infected through close contact with infected patients. The risk for infection can be significantly reduced through the appropriate use of infection control precautions and adequate barrier procedures. This is especially important when performing invasive procedures.

Introduction
Personal Protective Equipment
It is important that healthcare workers are adequately trained in the donning and removal of personal protective equipment (PPE) prior to dealing with patients suspected to have Ebola. According to the CDC, health care workers should have no skin exposed while caring for patients
with suspected Ebola or Viral Hemorrhagic Fever (VHF). It is also recommended that the practice of donning and removing PPE is supervised by a trained manager to ensure it is performed correctly.

Recommended Administrative and Environmental Controls
It is important to note that protecting healthcare workers and preventing spread of VHF requires that safe administrative procedures and safe work practices are carried out in the appropriate hospital settings. These controls include the following:

- At a senior management level, the hospitals infection prevention system, in collaboration with the occupational health department, should:
- Establish and implement triage protocols and procedures for patients entering the hospital to effectively identify patients under investigation for VHF and institute the precautions detailed by the CDC.
- The hospital should develop a policy for the management of suspected VHF patients and provide training for all staff prior to a patient arriving at the hospital.
- This is to ensure that clinical staff are debriefed in the safest way to nurse or care for these patients. Designate individuals as site managers responsible for overseeing the implementation of precautions for healthcare workers and patient safety. A site manager's sole responsibility is to ensure the safe and effective delivery of VHF treatment. These individuals are responsible for all aspects of VHF infection control including supply monitoring and evaluation with direct observation of care before, during, and after staff enter an isolation and treatment area.
- Identify the critical patient care required and essential healthcare workers for care of patients with EVD, for collection of laboratory specimens, and for management of the environment and waste ahead of time.
- Ensure healthcare workers have been trained in all recommended protocols for safe care of patients with EVD before they enter the patient care area.
- Train healthcare workers on all PPE recommended in the facility's protocols. Healthcare workers should practice donning and doffing procedures and must demonstrate during the training process competency through testing and assessment before caring for patients with EVD.
- Use trained observers to monitor for correct PPE use and adherence to protocols for donning and doffing PPE, and guide healthcare workers at each point of use using a checklist for every donning and doffing procedure.
- Document training of observers and healthcare workers for proficiency and competency in donning and doffing PPE, and in performing all necessary care-related duties while wearing PPE.
- Designate spaces so that PPE can be donned and doffed in separate areas.
- Key safe work practices include the following:
- Identify and isolate the patient with EVD in a single patient room with a closed door and a private bathroom as soon as possible.
- Limit the number of healthcare workers who come into contact with the patient with EVD (avoid short shifts) and restrict non-essential personnel and visitors from the patient care area.
- Always monitor the patient care area, and log at a minimum entry and exit of all healthcare workers who enter the room of a patient with EVD.
- Ensure that a trained observer watches closely each donning and each doffing procedure and provides supervisory assurance that donning and doffing protocols are followed.
- Ensure that healthcare workers have enough time to don and remove PPE correctly without disturbances.
- Ensure that practical precautions are taken during patient care, such as keeping hands away from the face, limiting touch of surfaces and body fluids, preventing needlestick and sharps injuries, and performing frequent disinfection of gloved hands using an alcohol-based hand rub, particularly after handling body fluids.
- Disinfect immediately any visibly contaminated PPE, surfaces, equipment, or patient care area surfaces using an *EPA-registered disinfectant wipe.

- Perform regular cleaning and disinfection of patient care area surfaces, even absent visible contamination.
- This should be performed only by nurses or physicians as part of patient care activities to limit the number of additional healthcare workers who enter the room.
- Implement observation of healthcare workers in the patient room, if possible (glass-walled intensive care unit [ICU] room, video link).
- Establish a facility exposure management plan that addresses decontamination and follow-up of an affected healthcare worker in case of any unprotected exposure. Training on this plan and follow-up should be part of the healthcare worker training.

Control Measures

- Standard, droplet and contact precautions always need to be applied. As the virus is spread through direct contact with the blood and body fluids (urine, faeces, saliva, vomit and semen) of a person, suffering from or having died with, Ebola and through direct contact with items that have been contaminated with the virus e.g. used needles, soiled clothing, bed linen etc. staff are required to observe the following at all times:
- Do not make contact (touch) the suspected or confirmed Ebola patient without properly applying full PPE under the observation of a designated manager trained to apply it.
- Limit contact and maintain maximum distance (at least 1.5 meters) even when PPE applied.
- Apply, use, remove and safely discard PPE in the presence of a designated buddy always. Staff must take the time to do this completely and assure themselves and the buddy that they are adequately protected.
- Only undertake necessary interventions. Decisions regarding any interventions and/ or treatments must be made by the senior attending clinician and must balance the patient's needs with the potential risks to staff safety.
- Implement standard, contact, droplet and airborne precautions with all persons suspected or confirmed as at risk of Ebola.

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EORNA best practice for COVID 19 pandemic in operating room

Statement

EORNA understands the severity of the pandemic caused by the SARS CoV-2 virus (Sever acute respiratory syndrome coronavirus 2), as well as all the difficulties caused by the pandemic at local and at global level. We are aware that the pandemic has caused many difficulties in organizing the work of operating room nurses as well as in creating favorable working conditions in operating rooms in circumstances of epidemic. In operating rooms, it is necessary to create conditions that ensure the maximum level of safety for patients and staff.

Key Words

SARS CoV-2, transmission, working conditions, education.

Purpose/objectives

The main goal of these recommendations is to create the safest conditions in operating rooms that will prevent the transmission of the virus from the patient to the staff and to other patients. For this purpose, a thorough reorganization of work in operating rooms, special working conditions and personal protection is needed. Late last year, the World Health Organization office in China reported cases of pneumonia of unknown etiology that were detected in Wuhan City, Hubei Province. From December 31, 2019 to January 3, 2020, China reported a total of 44 cases - patients with pneumonia of unknown etiology. During this period, the causative agent has not yet been discovered. On January 2, 2020, the World Health Organization launched the crisis management worldwide through regional and national offices. Meanwhile, a coronavirus disease, COVID-19, has been confirmed as an infectious disease caused by a new coronavirus. Most people suffering from COVID-19 disease do not require special treatment. In the elderly and people with chronic cardiovascular disease, diabetes, chronic kidney, lung and malignant diseases, severe forms of the disease can develop, sometimes with lethal outcome. Coronaviruses are viruses that circulate among animals but some of them can spread to humans. A genetic link has also been established to the SARS virus that appeared in 2003.

SARS CoV-2 virus has been identified as Biosafety level 3 (BSL) virus. [1]

To date, there are no recommendations in the literature or guidelines for the organization and work in the condition of COVID-19 infection, and only research results and recommendations published by the World Health Organization, the Centers for Disease Control and the European Center for Disease Control and national headquarters are available.

The purpose of these recommendations is to give guidelines to the hospitals how to establish an organize the work in accordance with the nature of the virus, its virulence, and modes of transmission.

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1 https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=2ahUKEwic3_yj57jpAhUKrosKHfMEANYQFjAAegQIARAB&url=https%3A%2F%2Fwww.cdc.gov%2Fcoronavirus%2F2019-ncov%2Flab%2Flab-biosafety-guidelines.html&usg=AOvVaw3KBDcbQDiqFkP1EyCh_1n

Transmission :

High virulence and strong pathogenicity of the causative agent are the basic characteristics of COVID-19 infection in which incubation lasts 2-14 days and which is transmitted by inhalation of infectious droplets or contact with infectious droplets from any other surface. Transmission can occur by the hands by transmitting viruses to the mucous membranes of the mouth, nose, or eyes from any surface. The most likely primary reservoir of the virus are bats, because genetic analyzes have shown that SARS CoV-2 is related to the SARS bat virus. The mediator/vector of the virus from animals to humans is not known yet, but the rapid spread of the pandemic is evidence that the virus is very easily transmitted from human to human. [2]

Symptoms of the infection can range from asymptomatic cases, mild fever, severe cough, shortness of breath, myalgia, diarrhea to severe pneumonia and the development of ARDS and multiple organic failures that lead to the death of the patient.

The risk of infection is increased in people who have stayed in areas that have been epidemic foci as well as in people who have been in close contact with people who had been infected with COVID-19 infection and have not used appropriate protective equipment during contact.

Studies prove that virus transmission by aerosol is possible in case of prolonged exposure to high aerosol concentrations in closed environment indoors.

Because the risk for the transmission of infection is extremely high, in first place it is necessary to protect the personnel who is working with patients that are suspected or who are positive for COVID-19 infection.

The hospital management must establish the crisis management for managing, organization and coordination in conditions of epidemic, which includes:

- Establishment of a crisis headquarters, regular communication with all hospital wards.
- Written policies and procedures for action
- Education, evaluation and monitoring of staff work.
- Determine the degree of risk for each patient.
- Determine the degree of risk for the staff.
- Separation of risk groups of workers.
- Organization of work in such a way that one part of the staff is at work in the hospital, one part of the staff stays at home, and staff changes take place every 7 days, optimally every 14 days.
- Mandatory identification and isolation of patients suspected or positive for COVID-19;
- Ensure the shortest possible exposure of the staff and limit the number of personnel caring for the patient.

Introduction

Personal protective equipment.

Personal protective equipment for the staff is the fundamental barrier in preventing infection of the staff members and the spread of this contagious disease and must be used in daily work in order to protect

[2] https://doi.org/10.4081/monaldi.2020.1298

personnel, patients and to prevent the spread of infection. The protective equipment also prevents the spread of infection to the materials and equipment used in the day-to-day health care practice. Personal protective equipment must be used rationally.

The CDC has developed a staff protection strategy taking into account that the following protective equipment must be used when working with patients with COVID-19 infection: eye protection, insulating gloves, gloves, foot covers, masks, N95 respirators, Powered air purifying respirators, disinfectants for hands and surfaces .

Staff must be trained how to use protective equipment; equipment must be used properly and rationally.

It is recommended to create a checklist to be used when putting on and disposing of protective equipment. Putting on and taking off protective equipment must be carried out in a precisely determined order.

Recommendations for the use of protective equipment include the following:

- Committees for nosocomial infections and hospital management must ensure:
- Written procedures and protocols for putting on and taking off protective equipment. Procedures and protocols must be updated and available to all health care professionals, must be in line with the recommendations of the relevant institutions and must be regularly updated.
- The operating rooms staff should be educated on the use of protective equipment, training should be evaluated and it is recommended that each employee signs a acknowledgment that he/she is educated and familiar with the use of protective equipment.
- Managers of operating rooms should determine the amount of protective equipment required on a weekly basis; the hospital management is obliged to provide the required amount of equipment accordingly.
- Sufficient time must be provided for putting on and removing protective equipment. It is also essential to mark places in operating rooms where putting on and taking off protective equipment is carried out and where surgical clothing worn outside OR is stored - surgical gown, sterile gloves. Outside the operating rooms, it is necessary to provide spots for the disposal of other protective equipment.
- It is recommended to use the following protective equipment when working in the operating room with a patient with suspected or confirmed COVID-19 infection:
  - Disposable or linen clothing for work in the operating room
  - Disposable surgical caps
  - Antivirus protective suits
  - FFP-2 mask
  - Goggles
  - Protective face shield
  - Closed working shoes
  - Foot covers
  - Nitrile gloves
  - Sterile surgical gowns and sterile gloves are worn over these protective clothing
- It is recommended to use disposable surgical drapes to cover the surgical field.
- After the end of the procedure, the protective equipment is disposed in the prescribed order:
  - Disposable surgical drapes that has been used to cover the surgical field is removed using the twisting method, so that the inside of the equipment is on the outside. The procedure is carried out slowly. The equipment is disposed into bags intended for infectious waste, which must be labeled COVID-19.

- The face shield is put off, the surgical gown is taken off together with the outer gloves and foot covers, the antiviral protective suit, the cap, the goggles and, as last, the surgical mask is removed, at the moment of taking off the surgical mask it is necessary to hold your breath briefly. It is mandatory to disinfect internal nitrile gloves between disposing of individual pieces of equipment.[3]

Air pressure in the operating room

Care for patients with COVID-19 infection requires a high level of protection for the health care personnel; for that reason a multidisciplinary approach is needed to ensure adequate working conditions in operating rooms, which includes ensuring adequate air pressure, air flow and disinfection of air in operating rooms, or ensuring conditions required for negative air pressure. Negative air pressure mitigates the transfer of aerosols through the space and to other surfaces by ensuring that air flow passes from a clean space to a smaller clean space. The CDC does not recommend placing operating rooms in negative pressure but treating them as if they were working with a patient with TBC, but with the obligatory use of an N95 or HEPA respirator. To ensure maximum safety of the staff in the operating room, it is recommended that the operating room where the patient is treated is converted to negative pressure space as follows:

- Converting the operating room into negative pressure space must be carried out by trained technical staff.
- The operating room must be separated from the ventilation system.
- The existence of negative pressure must be checked and proven, it should also be monitored.
- The operating room doors must always be closed .
- After the surgery is completed, it is recommended to disinfect the air in the operating room by ultraviolet irradiation.

- If in the operating room the negative pressure conditions cannot be obtained, the operating room door must be kept closed and staff must adhere to all safety measures and use the prescribed protective equipment.
- SARS-CoV-2 is a virus that cannot grow and multiply without an adequate host, so cleaning and filter replacement is performed according to standard procedures.
- Any action to establish negative pressure, maintain, clean and disinfect the ventilation system must be carried out by qualified staff.

The patient's entry into the operating room and the patient's stay in the operating room

- All patients who are suspected of having COVID-19 or who are positive for COVID-19 enter the operating room wearing a mask, whenever it is possible.
- It is recommended to anticipate and mark the corridors for patient’s passage through the operating block; immediately after the passage of the patient, the area through which the patient moved must be cleaned and disinfected.
- During the surgery in a patient suspected of having COVID-19 or who is positive for COVID-19, the presence of a minimum number of staff in the operating room must be ensured.
- All necessary materials must be provided to avoid moving outside the operating room and opening of the doors.

[3] Handbook of COVID-19 Prevention and Treatment – The First Affiliated Hospital Zhejlang Universyti School of Medicine, Compiled According to Clinical Experience.

- After the surgery is completed, the patient is taken out of the operating room through a designated and marked corridor and the area where the patient passed must be cleaned and disinfected immediately.

Cleaning and disinfection

- Cleaning and disinfection of surfaces plays a major role in stopping the transmission of the virus and therefore these are particularly important procedures in preventing the spread of COVID-19 infection.
- Since cleaning and disinfection are complex procedures in preventing the spread and combating this infection, these procedures must include, education, monitoring, surveys and reports in all key areas.
- For cleaning and disinfection procedures, it is necessary to write internal algorithms and protocols at the hospital level, which must be available to all employees.
- The basic principle of cleaning and disinfection is from less dirty to dirtier and from higher levels to lower levels.
- Products used for cleaning and disinfecting surfaces must be used according to the manufacturer's instructions and in the recommended concentrations to avoid exposure of personnel to chemical agents and to achieve a strong effect on the virus.
- Surface cleaners and disinfectants must be freshly prepared daily.
- For cleaning and disinfection of surfaces, it is recommended to use chlorine-based agents - calcium hypochlorite, no-touch technologies can be used - vaporized hydrogen peroxide and UV irradiation.
- If no-touch technologies are used for disinfection, each surface must first be cleaned by hand.
- Hand disinfection is performed before and after each contact with the patient, his environment, potentially infectious material and during the procedure of removing protective equipment.
- If hands are visibly contaminated, wash them with liquid soap and water before disinfection.
- For hand disinfection, products containing 60-95% isopropyl alcohol are recommended.
- It is mandatory to ensure the availability of hand detergents and disinfectants in all necessary positions.
- The treatment of surgical instruments after surgery is the same as in case of all other infections.

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